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THE FISHERIES AND AQUACULTURE SECTOR IN NATIONAL ADAPTATION PROGRAMMES OF ACTION: IMPORTANCE, VULNERABILITIES AND PRIORITIES

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THE FISHERIES AND AQUACULTURE SECTOR IN NATIONAL ADAPTATION PROGRAMMES OF ACTION: IMPORTANCE, VULNERABILITIES AND PRIORITIES

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PREPARATION OF THIS DOCUMENT

This circular was prepared under the "Climate Change, fisheries and Aquaculture: Understanding the Consequences as a Basis for Planning and Implementing Suitable Responses and Adaptation Strategies" project (GCP/INT/253/JPN) implemented by FAO, which aims at improving understanding of the consequences of climate change on the fisheries and aquaculture sector as well as moving towards guidelines and actions on improving the adaptive capacity of the sector. As part of the project's awareness-creation objectives, the project commissioned a desk study to analyse the existing national adaptation programmes of action (NAPAs) of least-developed countries (LDCs) to identify why and in what ways the sector has been identified as needing priority adaptation action and how this prioritization has transferred into actual projects through the Least Developed Countries Fund (LDCF) of the United Nations Framework Convention on Climate Change (UNFCCC). The work also forms part of FAO's actions in support of the UNFCCC, the Hyogo Framework for Action 2005–2015 on disasters and the implementation of the Millennium Development Goals (particularly on poverty, gender and hunger). Furthermore, the circular also aims to strengthen cooperation and coordination of aid under the Paris Declaration on Aid Effectiveness.

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The fisheries and aquaculture sector in national adaptation programmes of action: importance, vulnerabilities and priorities.
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ABSTRACT

The main purpose of this review is to support least-developed countries (LDC), development partners and donors in planning and implementing climate change adaptation actions for the fisheries and aquaculture sector. In particular, it is aimed at the LDCs eligible for support from the Least Developed Countries Fund (LDCF) (operated by the Global Environment Facility [GEF]), the GEF and its Agencies and the United Nations Framework Convention on Climate Change (UNFCCC) LDC Expert Group (LEG).

This desk study analyses the existing national adaptation programmes of action (NAPAs) of LDCs to identify why and in what ways the sector has been identified as needing priority adaptation action and how this prioritization has transferred into actual projects through the LDCF. The report: familiarizes fisheries and aquaculture decision-makers in LDCs with the NAPA process and the means for NAPA implementation; reviews country priorities *vis-à-vis* the fisheries and aquaculture sector; and provides those in the climate change arena with an understanding of the particular needs and vulnerabilities of the sector. The ultimate goal of the circular is to promote the inclusion of a traditionally under-represented but potentially highly vulnerable sector in the planning and implementation of climate change adaptation strategies.

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ABBREVIATIONS AND ACRONYMS

AfDB	African Development Bank
CZM	coastal zone management
CZME	coastal zones and marine environments
DRM	disaster risk management
EAA	ecosystem approach to aquaculture
ECB	education and capacity building
ENSO	El Niño Southern Oscillation
EWDM	early warning and disaster management
FCM	fish concentration mechanism
GDP	gross domestic product
GEF	Global Environment Facility
IBRD	International Bank for Reconstruction and Development
ICZM	Integrated coastal zone management
IFAD	International Fund for Agricultural Development
IPCC	Intergovernmental Panel on Climate Change
LDC	least-developed country
LDCF	Least Developed Countries Fund
LEG	Least Developed Countries Expert Group
MDG	Millennium Development Goal
MPA	marine protected area
NAPA	national adaptation programme of action
PSRP	poverty reduction strategy paper
SCCF	Special Climate Change Fund
SES	socio-ecological system
SIDS	Small island developing State
SIS	Safer Island Strategy (Maldives)
SLR	Sea-level rise
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

1. INTRODUCTION

It is often overlooked that more than 500 million people depend, directly or indirectly, on fisheries and aquaculture for their livelihoods. In addition, fish provides essential nutrition for about three billion people[1] and is highly traded with more than 37 percent of production entering international trade (FAO, 2009). In addition, fish exports from low-income food-deficient countries are equivalent to 50 percent of the cost of their food imports (FAO, 2005). The world's capture fisheries and the livelihoods they support (including in many least-developed countries [LDCs]) are already under threat from a range of factors. The majority of fisheries are considered to be already overexploited (FAO, 2011). The potential impacts of climate change on the sector in LDCs will further threaten the livelihoods and resources of a sector already in crisis.

This report provides an introduction to the national adaptation programmes of action (NAPAs) of LDCs that have been developed to identify "Priority activities addressing the urgent and immediate needs and concerns of the least developed countries (LDCs), relating to adaptation to the adverse effects of climate change" (UNFCCC, 2002) as well as an initial analysis of how the fisheries and aquaculture sector has been included in the existing NAPAs. The analysis looks specifically at the extent to which the fisheries and aquaculture sector has been included in the existing NAPAs as a priority activity and how this prioritization has been transferred into actual projects through the Least Developed Countries Fund (LDCF). The report briefly reviews indicators of importance for the sector as well as its vulnerability to climate change. In addition, gaps are identified where further attention is needed in mainstreaming fisheries and aquaculture into NAPAs and their implementation projects.

The report is intended to familiarize decision-makers in fisheries and aquaculture in LDCs with the NAPA process and the means for NAPA implementation. In addition, it provides those in the climate change arena with an understanding of the particular needs and vulnerabilities of the fisheries and aquaculture sector and, therefore, promote the inclusion of this traditionally under-represented sector in the planning and implementation process.

Although integrated (cross-sectoral) approaches to adaptation planning are fully supported by the authors, a sector-based approach has been adopted in this document to highlight the special characteristics of the fisheries and aquaculture sector with respect to mainstream agriculture, and its distinct interactions and needs with respect to climate change. As noted in FAO (2008a), "Wild capture fisheries are fundamentally different from other food production systems in their linkages and responses to climate change and in the food security outcomes. Aquaculture also has strong dependent linkages to capture fisheries, and both of these feed into distinct and specialized post-harvest and market chains. Conclusions on food supply and security derived from terrestrial contexts cannot usually be applied directly to the sector, and special consideration is needed to ensure policy and management responses are effective."

Furthermore, and in support of the Paris Declaration on Aid Effectiveness,[2] the report makes recommendations on the coordination and development of programmes to address priority climate change adaptation and related development issues.

2. NAPAS AND THE LDCF

This section provides a brief introduction to the development, implementation and content of NAPAs. For more detailed information, the reader is invited to visit the United Nations Framework Convention on Climate Change (UNFCCC) Least Developed Countries Portal,[3] which provides relevant guides developed by the UNFCCC LDC Legal Expert Group (LEG) as well as all submitted NAPAs.

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[1] In 2006, fish provided 2.9 billion people with at least 15 percent of their average per capita animal protein intake (FAO, 2009).

[2] Available at www.accrahlf.net

[3] http://unfccc.int/cooperation_support/least_developed_countries_portal/items/4751.php

2.1 NAPA objectives and process

In 2001, the seventh session of the Conference of the Parties to the UNFCCC (COP 7) acknowledged the specific needs and special situations of LDCs in that "they are least capable of dealing with the adverse effects of climate change". As part of a suite of activities targeting LDCs under the UNFCCC, LDCs[4] prepared NAPAs in order to "provide a process for least developed countries (LDC) to identify priority activities that respond to their urgent and immediate needs with regard to adaptation to climate change. The rationale for NAPA rests on the limited ability of LDC to adapt to the adverse effects of climate change."[5] National adaptation programmes of action are designed to coordinate and communicate priority actions to existing adaptation funding mechanisms, such as the LDCF discussed in this report.

In each country, a standard process for developing the NAPA was established and involved: (i) the setting up of a national NAPA team including representatives of key stakeholders, such as government agencies and civil society with a purpose to oversee preparation and implementation of the NAPA; (ii) the assembling of a broader team to collect information from the various sectors on expected impacts, vulnerability and adaptation measures as well as identify the criteria for defining priority activities; (iv) the identification of priority activities through a consultative process and development of profiles for these activities; and (iv) the development, public review and official endorsement of the NAPA. A synthesis of countries' reflections on the concerns, experiences and lessons in their NAPA preparation is available in a publication by the UNFCCC (2009a).

At the time of writing this report, NAPAs have been developed and submitted to the UNFCCC by 44 of the 49 LDCs and Cape Verde.[6] Those LDCs without NAPAs included Angola, Equatorial Guinea, Myanmar, Nepal, Somalia[7] and Timor-Leste.

2.2 Overview of NAPA activities by UNFCCC sectors

A major component of each NAPA was a list of ranked priority adaptation activities and projects, as well as short profiles of each activity or project. These were designed to facilitate the development of proposals for implementation of the NAPA. According to the UNFCCC scheme, the 467 priority activities proposed in the 44 NAPA documents fall into 12 main areas ("sectors" in the UNFCCC definition):

- agriculture and food security;
- coastal zones and marine ecosystems (CZME);
- water resources;
- terrestrial ecosystems;
- education and capacity building (ECB);
- early warning and disaster management (EWDM);
- tourism;
- insurance;
- infrastructure;
- health;
- energy;
- cross-sectoral.

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[4] The LDCs are under a special regime as referred to in Article 4, paragraph 9 of the UNFCCC.

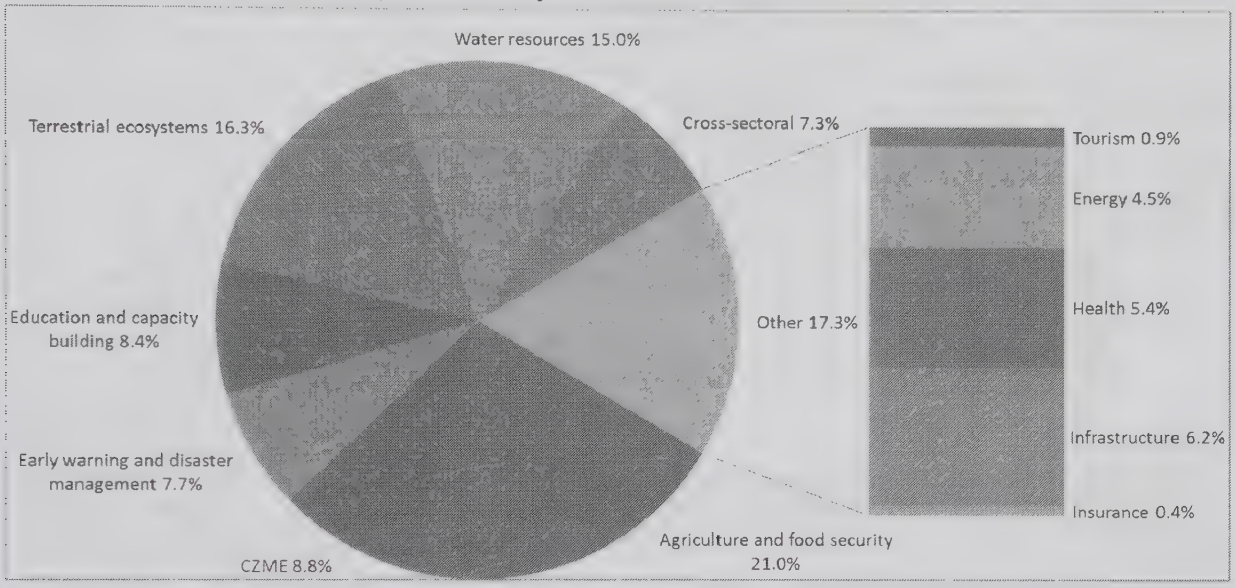
[5] The UNFCCC LDC portal at http://unfccc.int/cooperation_support/least_developed_countries_portal/items/4751.php

[6] See www.unctad.org/Templates/Page.asp?intItemID=3641&lang=1 for an up-to-date list of LDCs. Although it graduated from LDC status on 21 December 2007, Cape Verde has a registered NAPA. Therefore, it is included in this analysis.

[7] Somalia is not a party to the UNFCCC.

The largest category of NAPA priority activities addressed climate change impacts on issues of food security (98 activities, representing about 21 percent of all activities), followed by 73 activities targeting terrestrial ecosystems and 69 activities targeting water resources sectors (Figure 1). The CZME and ECB sectors held important shares of the NAPA priority activities, each with 8 percent of the total number of identified activities, while the EWDM sector is the focus area of 36 NAPA priority activities. The priority activities officially defined as cross-sectoral represent 7.3 percent of all NAPA priority activities; while the remaining 16 percent comprised activities targeting the infrastructure, health and energy sectors, and about 1 percent was represented by activities covering the tourism and the insurance sectors.

Figure 1
Distribution of NAPA priority activities by UNFCCC sector



Source: UNFCCC NAPA (http://unfccc.int/cooperation_support/least_developed_countries_portal/submitted_NAPA/items/4585.php).

The estimated cost of the priority activities identified in the 44 NAPAs analysed was approximately US$9 billion. However, as reported in UNFCCC (2009b), "it has been evident that there are underestimations in the figures presented in the NAPA documents"[8] and this reality is reflected when comparing the estimated cost of priority activities contained in the NAPA documents with the cost of the equivalent projects submitted to the Global Environmental Facility (GEF) for funding. For instance, Mozambique's LDCF-submitted project "Adaptation in the Coastal Zones of Mozambique", based on the NAPA priority activity "reduction of the impact of climate change in coastal zones", (whose estimated cost was US$2 million) presented an overall cost of US$13.3 million. This may be attributed to the fact that the LDCF projects have a broader scope in comparison with the NAPA activities and that often *one* LDCF project is based on *multiple* NAPA activities, as discussed more in detail in Section 4 of this report.

2.3 The LDCF for climate change adaptation

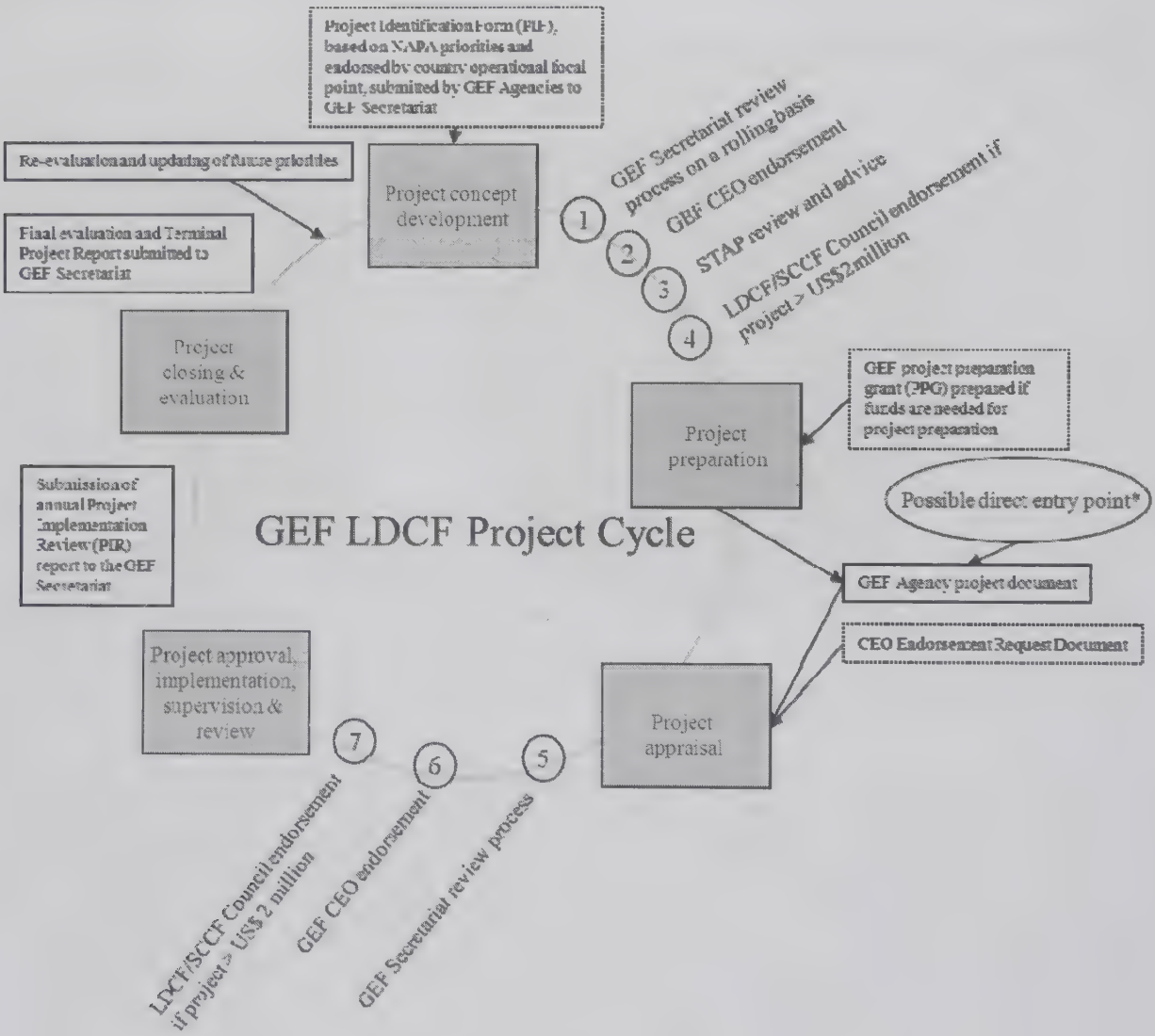
Global awareness of and the need for urgent planning and implementation for climate change adaptation has increased. Support and funding mechanisms to assist countries in these efforts have also been developed, including the creation of the UNFCCC Adaptation Fund, the Special Climate Change Fund and the Least Developed Countries Fund (LDCF). Annex 4 provides a non-exhaustive listing of adaptation and mitigation funds available as well as links to information for each fund. As

[8] LEG, 2009.

mentioned above, NAPAs were designed to communicate priority actions independently of the funding mechanisms ultimately used to implement them.

This report pays particular attention to the LDCF as it was created by the UNFCCC to support directly the development and implementation of the NAPAs and explicitly "addresses the special needs of the least developed countries (LDC), which are especially vulnerable to the adverse impacts of climate change."[9]

Figure 2
The LDCF project cycle



Notes: Guidelines and template forms are available on the GEF Web site (www.thegef.org/gef/guidelines).
* As part of an expedited one-step approval process, medium-sized projects (≤ US$2 million) not requiring a project preparation grant (PPG) may enter the LDCF project cycle directly at the "GEF Agency project document" stage along with an endorsement by the country Operational Focal Point.

As a GEF-administered fund, the LDCF follows the general modalities of the GEF Trust Fund but with certain differences in requirements that have been built in to acknowledge the nature of the countries targeted. The UNFCCC's step-by-step guide for implementing NAPAs (UNFCCC, 2009c)

[9] www.thegef.com/gef/ldcf

includes a useful section on the operational details of the LDCF for NAPA projects and the GEF project cycle for the LDCF (Figure 2); clarifying concepts that have been "designed to simplify project preparation and provide expedited access to LDCF resources". For example, the requirements for cofinancing under the LDCF mean that normal existing "baseline" activities, such as development projects, can be used for cofinancing. Separate funding is not required for the cofinancing, as is the case for projects under the GEF Trust Fund. The primary purpose of cofinancing under the LDCF is to show that the proposed project would be coherent with and builds on existing development activities, and the role of the LDCF would be to cover fully the additional costs that have arisen by the country's need to adapt to climate change.

3. FISHERIES AND AQUACULTURE IN NAPAS

This section presents the findings of a review of the NAPAs carried out to gain an understanding of whether the fisheries and aquaculture sector was considered a highly vulnerable sector at the time of the NAPA development. The analysis is divided into sections based on the following four key questions asked:

- Is the sector "important" to the country?
- What are the expected climate change impacts for the sector?
- What else can be said about the sector's vulnerability with respect to climate change?
- What adaptation strategies are proposed within the NAPA and elsewhere to address the sector's vulnerability?

3.1 Fisheries and aquaculture identified as a sector of national importance in NAPAs

3.1.1 Importance of the sector as identified in NAPAs

The concept of relative "importance" of the individual sectors was not consistently defined in the NAPAs nor during their development. Countries were allowed to define what sectors were important with respect to climate change adaptation in their context. Several countries identified fisheries and aquaculture as among the most prominent sectors for its contribution to food security, poverty reduction and the national economy. For example, Cape Verde described the fisheries sector as being essential to the country, particularly for sustaining the livelihoods of poor people. The Gambia listed fisheries as one of the principal export sectors, as did Maldives. Mauritania highlighted the economic potential of the fisheries sector for the country, accounting for more than 12 percent of gross domestic product (GDP). Solomon Islands recalled the importance of the fish processing industry, along with the primary fisheries industry, which represents one of the country's economic pillars. Another small island state, Vanuatu, stressed the relevance of the fisheries sector for the national economy, although it emphasizes that the industry has not yet reached its maximum potential.

3.1.2 Overview of contributions of fisheries and aquaculture to national economies and food and nutritional security

The following is a summary of the contributions the fisheries and aquaculture sector to the national economies of the LDCF-eligible countries from several published sources.[10] It is a rapid review of some national-level indicators to assist understanding of the dependence of a country on the sector. As such, the analysis is not exhaustive and must be seen as only one element in understanding the sector's vulnerability to climate change. The authors appreciate that the complexity of the sectors is not fully reflected here. It should also be noted that using national-level data will mask the subnational and local importance (as well as vulnerability) of the sector. In addition, the sector's contributions to human well-being are probably much higher than those indicated by official statistics in view of the incomplete information regarding small-scale and subsistence fisheries in both marine and freshwater

[10] For examples concerning the contributions of the sector, see: Gillet and Lightfoot (2001) for Pacific island countries; Kawarazuka (2010) for a literature review of the contribution of fisheries to food and nutrition security; and Béné, Bjorn and Allison (2010) for a look at the pro-poor functions of small-scale fisheries in developing countries.

systems in these countries (FAO, 2011). It should be noted that the information available did not allow for disaggregation of data by gender, poverty or other vulnerable groups.

The variables used to analyse the contributions of the fisheries and aquaculture sector at the national level were: production levels, production value as a percentage of GDP, trade values, employment and levels of apparent consumption of fish and fish products. The key indicators of relative importance of the sector used here include those appearing as column headings in Table 1.

Table 1
Overview of fishers contributions to national economies and food supply

Country	Fishers as % of economically active population[1]	Fisheries contribution to GDP[2]	Aquaculture production value[3]	Fisheries production value[2]	Fisheries export values[2]	Fisheries import values[2]	Per capita supply of fish per year[4]	Fish contribution to total proteins[4]	Fish contribution to total animal proteins[4]	Notes
	(%)	(%)	(US$ thousand)	(US$ thousand)	(US$ thousand)	(US$ thousand)	(kg)	(%)	(%)	
Afghanistan	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	0.1	No FAO CP
Angola	0.5	n.a.	n.a.	n.a.	61 500	213 948	15.7	9.1	29.66	FAO CP 2007
Bangladesh	1.9	3.92	1 246 479	2 435 370	458 358	5 118	13.3	7.8	55.47	FAO CP 2007
Benin	2.2	3.00	718	55 256	1 288	16 205	10.8	4.9	25.12	FAO CP 2008
Bhutan	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.1	0.2	1.3	No FAO CP
Burkina Faso	0.2	0.31	4	9 711	0	2 771	1.4	0.5	4.41	FAO CP 2008
Burundi	0.2	1.00	600	5 500	117	208	2.2	1.5	24.95	FAO CP (2003 data)
Cambodia	1.1	12.00	54 400	n.a.	34 500	5 400	23.1	12.9	52.52	FAO CP (2003 Fi GDP and trade data)
Cape Verde	7.7	0.80	n.a.	24 830	13 158	1 686	19.2	8	24.13	FAO CP 2008
Central African Republic	0.3	1.80	n.a.	10 000	0	1 086	4.4	2.8	7.46	FAO CP 2008
Chad	8.3	1.43	n.a.	112 000	3	1 461	6.8	2.8	17.06	FAO CP 2008 (GDP is 2006, Fi GDP is 2002)
Comoros	n.a.	15.29	n.a.	30 680	n.a.	177 000	20.1	15.2	53.73	FAO CP (1999 GDP and production data converted into US$)
Democratic Republic of the Congo	0.5	n.a.	7 419	n.a.	559	98 737	5.8	6.9	42.58	FAO CP 2009 (trade data converted into US$)
Djibouti	0	< 0.1	n.a.	400 000	73	495	1.1	0.6	1.94	FAO CP (2001 trade data)
Equatorial Guinea	n.a.	n.a.	n.a.	11	10 516	2 565	23.1	28.6	54.36	FAO CP (2001 trade data)
Eritrea	0.8	0.90	n.a.	5 500	2 100	100	1.6	1	7.74	FAO CP (2000 Fi GDP and trade data)
Ethiopia	0	0.05	n.a.	3 563	108	78	0.1	0.1	0.67	FAO CP (2001 Production and trade data)
Gambia	0.3	0.13	n.a.	n.a.	919	365	28.0	14.6	59.02	FAO CP 2007
Guinea	0.3	3.60	n.a.	78 000	2 408	5 227	14.3	8.1	47.61	FAO CP (2003 data converted into US$)

Country	Fishers as % of economically active population[1]	Fisheries contribution to GDP[2]	Aquaculture production value[3]	Fisheries production value[2]	Fisheries export values[2]	Fisheries import values[2]	Per capita supply of fish per year[4]	Fish contribution to total proteins[4]	Fish contribution to total animal proteins[4]	Notes
	(%)	(%)	(US$ thousand)	(US$ thousand)	(US$ thousand)	(US$ thousand)	(kg)	(%)	(%)	
Guinea Bissau	0.5	3.70	n.a.	n.a.	6 300	487	1.8	1.2	5.77	FAO CP (The whole industry contributes 15.8%)
Haiti	0.1	0.50	n.a.	16 640	3 902	8 228	2.6	1.5	8.16	FAO CP (2003 data converted into US$)
Kiribati	3.4	21.54	176	14 200	1 485	424	75.5	29.7	58.28	FAO CP (1999 data)
Lao People's Democratic Republic	0.6	6.80	91 938	119 000	25	3 331	17.6	8.4	42.19	FAO CP (2004–95 data)
Lesotho	0	n.a.	2	n.a.	9	502	n.a.	n.a.	n.a.	FAO CP 2008
Liberia	0.4	7.63	n.a.	n.a.	702	3 177	4.4	3.9	25.58	FAO CP (2005 data)
Madagascar	1.1	2.88	34 000	n.a.	162 606	32 102	7.0	4.7	18.95	FAO CP 2008
Malawi	0.8	4.00	1 372	n.a.	280	277	4.6	2.5	33.86	FAO CP (2003 data)
Maldives	n.a.	6.00	n.a.	n.a.	124 347	8 509	184.4	54.1	79.8	FAO CP 2009
Mali	1.3	4.20	1 011	188 228	244	5 617	7.6	3.2	12.79	FAO CP (2005 data converted into US$)
Mauritania	0.7	11.00	n.a.	n.a.	153 655	5 219	17.5	6.1	14.48	FAO CP (2004 data converted into US$)
Mozambique	0.2	4.00	6 803	80 000	96 638	31 776	5.0	3.6	35.61	FAO CP 2007 (2005 production data; 2006 trade data)
Myanmar	2.4	8.94	1 472 320	n.a.	318 514	1 267	23.4	7.3	47.51	FAO CP (2004 data)
Nepal	n.a.	1.50	31 438	29 300	n.a.	n.a.	1.5	0.7	4.78	FAO CP (1995–96 data)
Niger	0.1	2.14	84	59 621	2 965	770	3.7	2	12.68	FAO CP 2007 (GDP 2005; Production 2004 and trade 2005– converted into US$)
Rwanda	1.3	0.33	485	239	n.a.	589	1.0	0.7	7.04	FAO CP (2005 data converted into US$)
Samoa	n.a.	6.65	n.a.	42 900	7 600	n.a.	58.7	20.6	34.56	FAO CP 2009
Sao Tome and Principe	5.1	3.42	n.a.	9 749	22	99	20.5	11.3	44.92	FAO CP 2008 (GDP and trade 2006 converted into US$)
Senegal	1.3	1.90	248	223 165	194 481	1 072	28.4	14.5	48.5	FAO CP 2008
Sierra Leone	1.1	9.40	n.a.	107 917	11 081	1 419	19.0	13.6	64.81	FAO CP 2008
Solomon Islands	4.9	12.80	6	79 204	35 472	237	47.2	27.9	81.28	FAO CP (1999 data)
Somalia	n.a.	2.00	n.a.	55 000	3 394	142	1.6	1.1	1.72	FAO CP 2005
Sudan	0.2	<0.1	2 280	1 200	675	562	1.7	0.7	1.94	FAO CP 2008
United Republic of Tanzania	0.5	2.90	1 236	n.a.	145 244	540	7.0	5.6	27.67	FAO CP 2007
Timor-Leste	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.5	0.2	0.65	NO FAO CP
Togo	0.7	1.30	2 724	17 290	12 490	6 408	9.2	5	38.57	FAO CP 2007 (2005 production data; 2006 trade data– converted into US$)
Tuvalu	n.a.	7.05	2	1 200	4 232	n.a.	41.7	12.8	27.8	FAO CP (1999 data)
Uganda	0.5	1.30	11 913	72 000	40 631	n.a.	8.8	4.5	27.88	FAO CP (GDP 2002; production 2001)
Vanuatu	12.	2.22	4	4 554	1 086	1 185	30.9	15.2	38.78	FAO CP (1999 data)

Country	Fishers as % of economically active population[1]	Fisheries contribution to GDP[2]	Aquaculture production value[3]	Fisheries production value[2]	Fisheries export values[2]	Fisheries import values[2]	Per capita supply of fish per year[4]	Fish contribution to total proteins[4]	Fish contribution to total animal proteins[4]	Notes
	(%)	(%)	(US$ thousand)	(US$ thousand)	(US$ thousand)	(US$ thousand)	(kg)	(%)	(%)	
	3									
Yemen	0.2	2.40	n.a.	125 000	19 800	40 000	6.3	3.4	16.2	FAO CP 2002
Zambia	0.5	2.26	n.a.	316 000	1 900	4 900	6.4	3.9	21.72	FAO CP (2004–05 data)

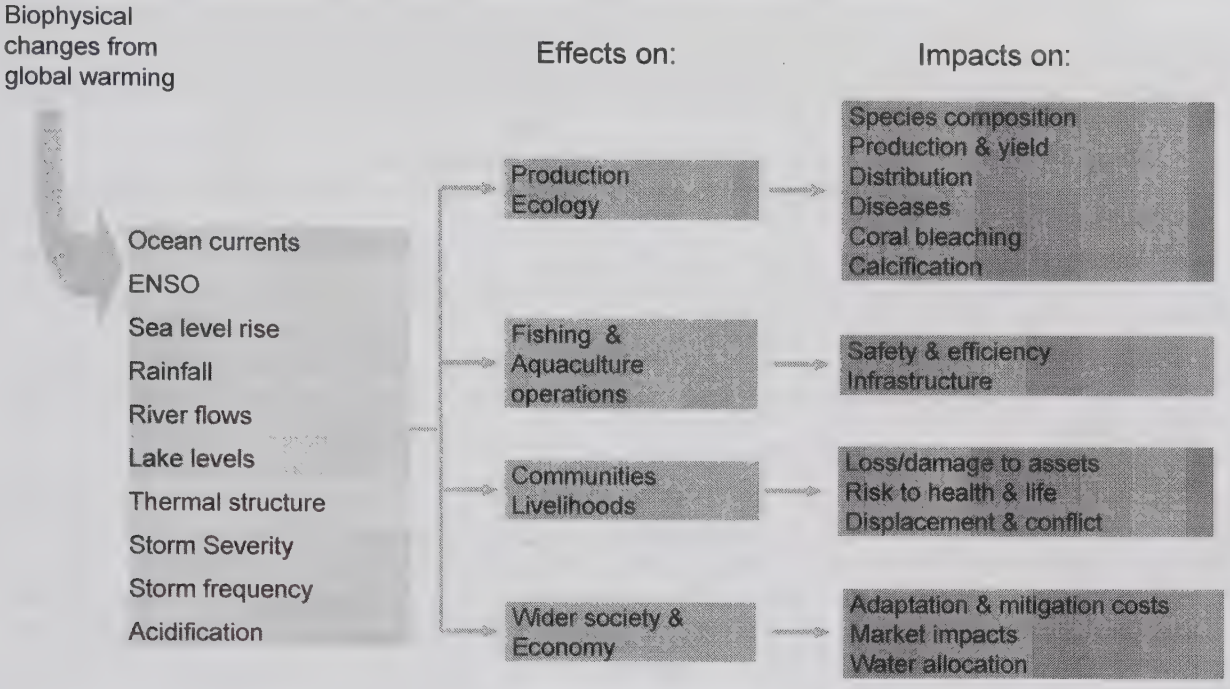
Notes: n.a. = not available; CP = country profile.
Sources: [1] = Allison *et al.*, 2005; [2] = FAO Country Profiles; [3] = FAO FishStat Plus; [4] = Laurenti, 2007.

This analysis reveals a wide range of "relative importance" that fish has for both in the economies and diets people in these LDCs. It should be noted that culture can have a significant impact on consumption rates of fish in many countries. Somalia, for example, has traditionally pastoralist communities with historically low fish consumption rates. It is also not surprising that in landlocked countries such as Afghanistan, Bhutan and Nepal, fish has relatively limited importance to the diet and economy. Similarly, for island States with rich fisheries resources, such as Vanuatu, Maldives and Kiribati, the sector is significant both for the economies and for food and nutrition security.

The important role of fisheries and aquaculture for food and nutrition security in these developing countries in terms of caloric intake, protein and fat availability as well as providing for a wide range of essential vitamins and minerals, particularly in the LDCs, is acknowledged by several studies.[11] Indeed, most LDCs rely on fish as a critical source for their per capita daily protein intake. For example, in 2003, the average percentage of fish in the total protein consumption for Asian and Pacific LDCs was about 17 percent, with a mean value of fish available for annual consumption of close to 35 kg per capita (Laurenti, 2007). The contribution of fish to the food basket among sub-Saharan LDCs was significant as well, with an annual average of 9.4 kg per capita apparent consumption of fish. Individual country per capita consumption of fish as a percentage of total animal protein ranged from zero to 54 percent among the LDCs. As stated, Maldives, Solomon Islands, Sierra Leone, Kiribati, Bangladesh and the Gambia are among the countries with the highest values of nutritional dependence on fisheries (Laurenti, 2007).

[11] See, for an overall review, Béné, Macfadyen and Allison (2007) and Kawarazuka, N. (2010).

Figure 3
Examples of climate change impact pathways to fisheries and aquaculture



Source: Badjeck *et al.*, 2010.

Such data are particularly relevant in countries that are highly food insecure, as is the case in most LDCs. For the period 2004–06, the percentage of the population that was undernourished among sub-Saharan countries was close to one-third, and 17 percent among Asian and Pacific countries (FAOSTAT, 2010). In Cambodia, fish ranks second after rice in diets, and 54 percent of households consume fish every day (Kawarazuka, 2010). In Zambia, some communities rely entirely on fish as a source of food and for their livelihoods (Kawarazuka, 2010). In addition, the nutritional role of fisheries also contributes to reducing child mortality and to improving maternal and child health (Finegold, 2009).

3.2 Main climate change impacts affecting fisheries and aquaculture

3.2.1 Overview of climate-driven changes affecting fisheries and aquaculture

A wide range of impacts on the fisheries and aquaculture sector have been predicted (Barange and Perry, 2009). Biophysical changes from global warming may affect ocean currents, the El Niño Southern Oscillation (ENSO), sea levels, rainfall, river flows, lake levels, thermal structure, storm severity and frequency, and acidification.

Fisheries- and aquaculture-dependent economies, coastal communities and fisherfolk and fish farmers are expected to experience the effects of climate change in a variety of ways (Daw *et al.*, 2009 and Badjeck *et al.*, 2010). As depicted in Figure 3, some climate change effects will affect fishing and aquaculture activities and communities directly through physical changes to the working and living environments, other effects will have less direct impacts through changes in the ecological and biological processes, and there will also be effects with indirect, although potentially quite important, impacts through, for example, changes in water management policies and migration of displaced people to the coasts.

3.2.2 Climate change stressors to the fisheries and aquaculture sector identified in NAPAs

The most recurrent stressors affecting the sector's resilience to climate change, as reported in the NAPA documents, include:

- Reef disappearance and coral bleaching. As indicated in the Comoros NAPA, "Reefs disappearance favours coastal erosion and speeds up the diminution of coastal fishing". The health of coral reefs is of primary importance to fisheries as they provide 25 percent of fish harvest in developing countries (and about US$5.7 billion in global fisheries benefits per year),[12] and they are particularly important for small-scale fisheries, which generally operate in coastal waters.
- Sea-level rise (SLR). The rise in sea levels may cause intrusion in coastal areas, increasing the salinity of underground and shallow waters. Coastal erosion may be another consequence of SLR.
- Droughts. Droughts may induce water shortages, some human diseases and decline in soil fertility, leading to food insecurity. Zambia includes the reduction of fish stocks in freshwaters among the consequences of droughts.
- Floods. The effects of floods can be devastating on human health, property, watercourses and ponds. Damage caused by floods can jeopardize fishing activities and result in heavy loss of income.

Table 2 describes the impacts caused by the changing climatic conditions on fisheries and marine ecosystems as noted in 36 LDCs that have either formulated adaptation priority activities in their NAPAs or submitted LDCF projects covering the fisheries and aquaculture sector. Three types of impacts were most significant for marine and aquatic fisheries: the degradation and/or changes of the coastal and aquatic ecosystems; the perceived depletion and/or reduction of fish stocks; and risks associated with severe weather events.

Cochrane *et al.* (2009) provide an overview of current scientific knowledge regarding the biophysical changes associated with climate change and their potential impacts on fisheries and aquaculture. This analysis remains at the global or regional scale, and much work needs to be done to downscale such information for use in adaptation planning at the national and local levels. However, it is important to note that the impacts are consistent with predicted impacts and that many of these impacts are already occurring.

[12] The total net benefit per year of the world's coral reefs has been estimated at US$29.8 billion, comprising the following services: tourism and recreation (US$9.6 billion), coastal protection (US$9.0 billion), fisheries (US$5.7 billion), and biodiversity US$5.5 billion (Cesar, Burke and Pet-Soede, 2003).

Table 2
Actual and projected climate change impacts on fisheries and aquaculture identified in NAPAs

Country	NAPA reported impacts
Bangladesh	Saline intrusion in coastal zones Increased monsoon season Increasing intensity of cyclone frequency (especially in Bay of Bengal) Sea-level rise Increased floodings Temperature rise and drought
Benin	Sea-level rise Saline intrusion in coastal areas Human diseases associated with floods and droughts
Burundi	Decline in lake and waterway levels Longer dry seasons Torrential rainfalls Recrudescence of waterborne diseases
Cambodia	Sea-level rise Decreased reservoir fish stock capacities Increased floods Shallowing of waterways Changes in water flows and availability
Cape Verde	Deterioration of marine ecosystem Species disappearance
Chad	Decline in lake and waterway levels Migration of large populations towards Lake Chad and other waterbodies Depletion of fish stocks
Comoros	Coral bleaching Reduction/decrease of reef fish
Democratic Republic of the Congo	River floods Coastal erosion Torrential rainfall Seasonal drought Temperature rise
Djibouti	Coral bleaching Floods Droughts Saline intrusion in coastal areas Sea-level rise Temperature rise
Ethiopia	Droughts Flash floods River floods
Gambia	Changing heat budget of the overlying ocean, CO_2 enrichment, and seasonal upwelling leading to initial increases in fish productivity but potential long-term decreases Sea-level rise Loss of fisheries habitats Collapse of some pelagic stocks
Guinea	Drying up of waterways Sea-level rise Temperature rise Droughts and floods and changes in rainfall patterns

Country	NAPA reported impacts
Guinea-Bissau	Direct links of climate change impacts on sector unknown but presumed linked to species migrations Decreased rainfall and rise in water salinity affecting fisheries habitats Sea-level rise Changes in coastal zone physical processes affecting aquatic biodiversity Acidification Cyclones and strong winds
Haiti	Coastal erosion Floods Droughts Saline intrusion in coastal zones
Kiribati	Deterioration of coastal ecosystem Depletion of fish stocks Fish poisoning
Lao People's Democratic Republic	Floods Droughts
Liberia	Loss of biodiversity Coastal erosion
Madagascar	Saline intrusion Coral bleaching Loss of biodiversity Droughts Floods Cyclones
Malawi	Drying of lakes Destruction of fish ponds (due to floods)
Maldives	Geographic variations in fish catch affecting some atolls (tuna is the main capture species)
Mali	Droughts Strong winds Temperature changes
Mauritania	Disturbance of the biotopes of some species and the dwindling stocks of some populations Alterations in marine currents, temperature, salinity, etc. and general movement of the oceans, the rising of the sea level, etc, will certainly have an effect on the productivity of these ecosystems, the marine and coastal habitat and the diversity of the resource. Heavy flooding
Mozambique	Droughts Floods Tropical cyclones
Niger	Reduction of surface waters and decrease of the groundwater Watercourses silting up Drying of wetlands Torrential rainfall
Samoa	Water temperature increases and coral bleaching Tropical cyclone induced waves causing coastal flooding, erosion and landslides
Sao Tome and Principe	More frequent storms threatening fishers' lives
Senegal	Sea-level rise Saline intrusion in coastal zones Droughts
Sierra Leone	Loss of biodiversity Depletion of fish stocks

Country	NAPA reported impacts
Solomon Islands	Loss of biodiversity Depletion of fish stocks
Sudan	Droughts Floods Dust storms
Togo	Sea-level rise Saline intrusion in coastal zones
Tuvalu	Coral bleaching Reduction of shellfish population Declining trend for food fish and selected invertebrates
United Republic of Tanzania	Deterioration of marine ecosystem (mangroves, sea grass beds, fish and corals)
Vanuatu	Marine pollution[1] Ciguatera poisoning
Yemen	Impacts on fish at specific locations, such as changes in productivity or health Impacts on the spatial distribution of fish populations
Zambia	Lower rainfall reducing nutrient levels in rivers and lakes and negatively affecting fish breeding activity, as well as depletion of fish species in the long term Disease outbreaks Droughts, floods, extreme heats leading to reduced fish stocks and catches

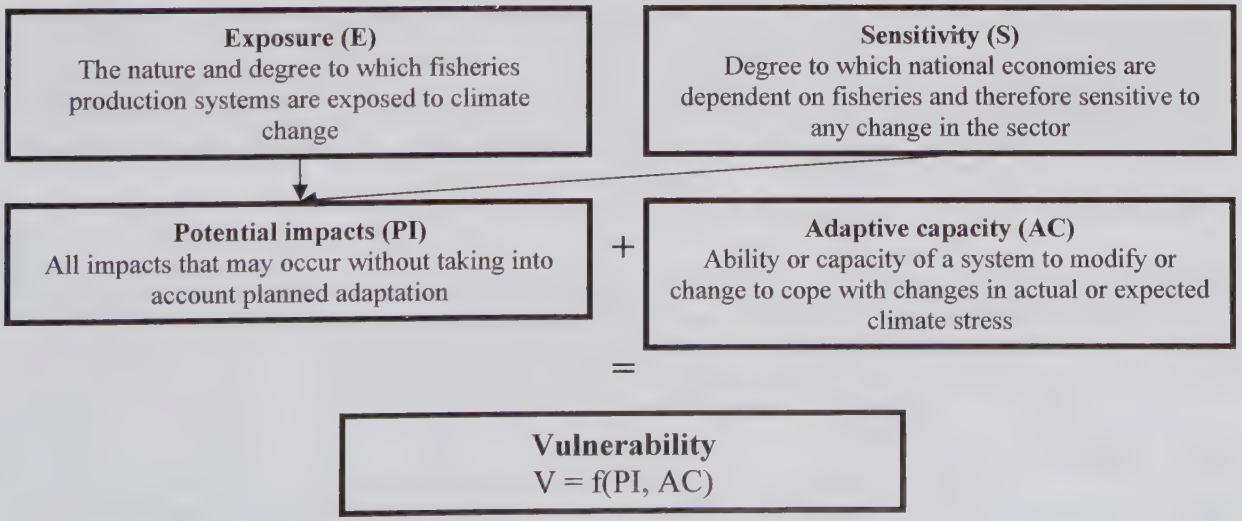
[1] Note that marine pollution is considered to be a climate change-related consequence by the country.

3.3 Vulnerability of the fisheries and aquaculture sector

3.3.1 Overview

According to the Intergovernmental Panel on Climate Change (IPCC) (2001), the vulnerability of a natural or social system to climate change impacts entails three factors: (i) the exposure of a system to climatic hazards; (ii) the sensitivity of the system to change, or the degree to which the system is likely to be affected (positively or negatively) by such impacts; and (iii) the adaptive capacity of the system, which includes the ability of the system to adjust its practices, processes or structures to offset or take advantage of any resulting changes. This model, as applied to the fisheries and aquaculture sector is presented in Figure 4.

Figure 4
A model for understanding vulnerability in fisheries and aquaculture



Source: FAO, 2007.

Vulnerability in the fisheries and aquaculture sector and all food production sectors is influenced by the interactions between human activities and ecological systems; therefore, the complex socio-ecological system (SES) becomes the object of vulnerability analyses in the sector. As a starting point, four main elements define the scale of the SES of fisheries and aquaculture systems: the geographic location (region of the world), the dimensional scale (small-scale, large-scale), the type of fisheries (capture, culture) and the subsector (marine, inland). For example, in many LDCs, capture fisheries are located in tropical climate zones, are of a mixed-species and small-scale nature and based in marine environments. Such information and existing knowledge about impacts and adaptive capacity on certain classifications of SESs may prove efficient in developing adaptation strategies where little information is available.

The results of a project funded by the Department for International Development of the United Kingdom, which was the first global attempt at defining national economies' vulnerability to the impacts of climate change on fisheries, are represented in Figure 5.[13] Based on the IPCC definition of vulnerability, national-level vulnerability indicators for the fisheries sector were calculated for 132 countries. The analysis revealed that 16 African LDC and 3 Asian LDCs were deemed to be among the highly vulnerable countries. However, data were lacking for 21 LDCs, which were, therefore, not included in the final vulnerability rankings.

Figure 5
Vulnerability of national economies to potential climate change impacts on fisheries

Source: Badjeck *et al.*, 2010.

One should note that many fishing and coastal communities already subsist in precarious and vulnerable conditions because of poverty and rural underdevelopment, with their well-being often undermined by overexploitation of fishery resources and degraded ecosystems. As the vulnerability of fisheries and aquaculture systems and communities depends not only on their exposure and sensitivity

[13] See Allison *et al.* (2005), Allison *et al.* (2009) and Badjeck *et al.* (2010). Although comprising elements of aquaculture (e.g. trade data are not separated into fisheries and aquaculture subsectors), a separate study by the Department for International Development of the United Kingdom focused on the aquaculture subsector (Handisyde *et al.*, 2006).

to change, but also on the ability of individuals or systems to anticipate and adapt, these communities tend to be among the most vulnerable (Daw *et al.*, 2009).

For example, while many African marine coastal fisheries are not likely to face huge physical impacts, the region's adaptive capacity to respond to climate change is relatively low, rendering communities there highly vulnerable even to minor changes in climate and temperature. Small island developing States – which depend on fisheries and aquaculture for at least 50 percent of their animal protein intake – are in a particularly vulnerable position. Inland fisheries (most of which are in developing African and Asian countries) are also at high risk, threatening the food supply and livelihoods of some of the world's poorest populations. Aquaculture, a sector of particular significance for populations in Asia,– stands to be affected by SLR as well as temperature increases in temperate zones that could exceed the optimal range for many of the organisms that are being cultured today and could also facilitate the spread of fish diseases.

3.3.2 Vulnerability of the fisheries and aquaculture sector as identified in NAPAs

In the NAPAs, the definition of vulnerability to climate change was not consistent across countries and, often, vulnerability was limited to potential exposure to physical changes.

In describing the vulnerability of the fisheries and aquaculture sector, the countries have focused on three elements: the climate impacts already occurring and affecting the sector; the human activities that can cause damage to the fisheries and aquaculture environments; and the factors of weakness that contribute to making the sector vulnerable.

The human activities and weakness factors potentially impairing the productivity and health of the fisheries and aquaculture sector should be considered when assessing the sector's adaptive capacity (one of the four elements of the vulnerability model discussed above), as they influence the response capacity of a system; hence, reducing its ability to adapt.

A few countries identified the climate changes that can adversely affect their fisheries and aquaculture sector, such as the expected rises in sea level and air temperature and their negative effects on fish stocks availability in some areas.

Table 3 shows the definitions of vulnerability as reported in the NAPAs, grouped under three columns: one including the climate-related stressors on the fisheries and aquaculture sector; one concerning the human activities; and one the "weakness factors". The latter two influence the adaptive capacity of the fisheries and aquaculture sector.

Table 3
Factors of vulnerability as reported in NAPAs

Climate-related stressors affecting the sector	Human activities influencing the sector's adaptive capacity	"Weakness factors" influencing the sector's adaptive capacity
– Floods – Droughts – Coral bleaching – Coastal erosion – Drying up of waterbodies – Fish poisoning, mangrove and coastal vegetation disappearance – Saline intrusion – Loss of biodiversity – Changes in spatial distribution of fish populations – Sea-level rise	– Unplanned economic growth – Pressure on the marine, land and coastal environments owing to intense construction and industrial activities – Destruction of habitats (wetlands and mangrove swamps) owing to overexploitation – Unsustainabie treatment of industrial and domestic waste – Overfishing – Intense extractive activities on reefs – Unsustainable use of watersheds	– Low productivity rate of fish stocks – High dependence on one type of fisheries activity (like pole and line tuna fishery in Maldives) – Illegal fisheries – Lack of coastal zone management and surveillance over fisheries activities – Lack of regulation of industrial and domestic waste – Conflicts over resource use – Inefficient forecasting systems – Population migration owing to climate-related adverse events – Health problems (illness provoked by climate stressors, AIDS)

3.4 Fisheries and aquaculture adaptation measures identified as priority activities in NAPAs

3.4.1 Overview

Developing countries urgently need to plan and implement adaptation strategies for coping with climate change impacts.[14] Some of these impacts are already affecting important assets, such as land and water ecosystems, critical resources for the food security and the well-being of populations. Adaptation is a process that aims to develop resilience and capacity in vulnerable communities to enable them to prepare for and respond to potential shocks and trends with minimum costs but also to enable them to take advantage of new opportunities. With regard to the fisheries and aquaculture sector, discussion regarding adaptation strategies can have at least four entry points: livelihood strategies; governance regimes; disaster risk reduction and management; and planned adaptation (Daw *et al.*, 2009).

Livelihood strategies for adaptation should, wherever possible, be diversified in order to develop resilience to erratic environmental and economic conditions. Fishing and aquaculture activities are likely to face increasing stress through hydroclimatic factors, storms, SLR, changing temperatures, coral bleaching, and fish availability variations. This is in addition to those stressors already affecting the sector, such as overfishing and habitat destruction. In West Java, Indonesia, for example, coastal artisanal fishers for small pelagic fish species undertake rotating activities such as rice farming, tree-crop farming and fishing in response to seasonal and interannual variations in fish availability. (Allison, Beveridge and van Brakel, 2009).

Governance regimes should be flexible and adaptive as climatic conditions become more unstable and unpredictable (only increasing uncertainty in decision-making). In Palau, for example, the implementation of flexible regulatory frameworks sustained the fisheries sector by limiting fishing in inland lagoons to periods when fishing at sea was prevented by bad weather. Allowing access to neighbouring community-controlled fishing grounds was permitted in exchange for part of the catch in times of local scarcity and ensuring redistribution of fishing rights among neighbouring municipalities (Allison, Beveridge and van Brakel, 2009).

Disaster risk reduction and management strategies should be included in the development of adaptation strategies, as natural disasters are expected to increase in frequency and intensity with climate change. An example of such strategies exists in the Bay of Bengal, where cyclones often disrupt fishing activities. Fishers receive up-to-date weather forecasts and severe weather warnings via mobile phone messages, allowing them to reduce risk through early warning.

Planned adaptation, through specific "plans of action" and national programmes of action, assists in coordinating activities and defining integrated strategies for addressing vulnerabilities to climate change impacts. However, certain adaptation measures that are considered appropriate for some sectors may benefit or conflict with the adaptation needs of other sectors. It is, therefore, important that a stakeholder identification and consultation that is as broad as possible be included in integrated adaptation planning, especially when resources and access to resources are shared or affected by several sectors.

Many of the adaptation measures that have been designed for the fisheries and aquaculture sector are carried out under the input and the guidance of public institutions (Table 5). The important function of the public sector (constituted by local, national or regional institutions and agencies) derives from the fact that many of the potential adaptation measures address management and governance issues, with an inherent "public good" nature of the service in many countries. Examples of public adaptation measures include: (i) the adoption of integrated and adaptive approaches to management (e.g. integrated zone management, community-based management and ecosystem approaches); (ii) the establishment of early warning systems (e.g. weather observatories and sea fluctuations monitoring

[14] "It is urgent that the vulnerability of developing countries to climate change is reduced and their capacity to adapt is increased." UNFCCC (2007).

and action systems, aquatic resources and ecosystems monitoring systems); (iii) the implementation of education programmes for target groups; (iv) the activation of income support or sector enhancement programmes; and (v) the development of safety net mechanisms, such as public insurance systems where not provided naturally by the private sector.

Table 4
Examples of adaptations to climate change impacts in the fisheries subsector

Impact on fisheries	Potential adaptation measures	Responsibility	Time scale
Reduced fisheries productivity and yields (indirect ecological)	Access higher value markets	Public/private	Either
	Increase effort or fishing power*	Private	Either
Increased variability of yield (indirect ecological)	Diversify livelihood portfolio	Private	Either
	Insurance schemes	Public	Anticipatory
	Precautionary management for resilient ecosystems	Public	Anticipatory
	Implementation of integrated and adaptive management	Public	Anticipatory
Change in distribution of fisheries (indirect ecological)	Private research and development and investments in technologies to predict migration routes and availability of commercial fish stocks	Private	Anticipatory
	Migration	Private	Either
Reduced profitability (indirect ecological and socio-economic)	Reduce costs to increase efficiency	Private	Either
	Diversify livelihoods	Private	Either
	Exit the fishery for other livelihoods/investments	Private	Reactive
Increased vulnerability of coastal, riparian and floodplain communities and infrastructure to flooding, sea level and surges (direct)	Hard defences	Public	Anticipatory
	Managed retreat/accommodation	Public	Anticipatory
	Rehabilitation and disaster response	Public	Reactive
	Integrated coastal management	Public	Anticipatory
	Infrastructure provision (e.g. protecting harbours and landing sites)	Public	Anticipatory
	Early warning systems and education	Public	Anticipatory
	Post-disaster recovery	Public	Reactive
	Assisted migration	Public	Reactive
Increased risks associated with fishing (direct)	Private insurance of capital equipment	Private	Anticipatory
	Adjustments in insurance markets	Private	Reactive
	Insurance underwriting	Public	Reactive
	Weather warning system	Public	Anticipatory
	Investment in improved vessel stability/safety	Private	Anticipatory
	Compensation for impacts	Public	Reactive
Trade and market shocks (indirect socio-economic)	Diversification of markets and products	Private/public	Either
	Information services for anticipation of price and market shocks	Public	Anticipatory
Displacement of population leading to influx of new fishers (indirect socio-economic)	Support for existing local management institutions	Public	Either
Various	Publicly available research and development	Public	Anticipatory

* Adaptation measures that would probably exacerbate any existing overexploitation of fisheries.
Source: Daw *et al.*, 2009.

Examples of private actor and/or sector adaptation measures include: livelihoods diversification; changes in fishing strategies (including exiting the sector); and the purchasing of private insurance. Two example adaptation measures of a mixed public/private form include accessing higher valued markets and the diversification of markets and products. It should be noted that these roles are not delimiting and that public/private sector interaction is likely and highly encouraged for any adaptation strategy, such as combining public social insurance and private insurance schemes. In addition, non-governmental actors (such as community-based and non-governmental organizations) may have the ability to react more quickly and in a more flexible fashion than centralized institutions; further supporting the need to include all stakeholders in adaptation planning and implementation.

Table 5
Examples of climate change impacts on aquaculture systems and potential adaptive measures

Aquaculture/ other activity	Impact			Adaptive measures/opportunities
	Env	*+/–*	*Type/form*	
			Warming	
Cage, pond; finfish	All	–	Temperature raise above optimal range of tolerance	Better feeds; selective breeding for higher temperature tolerance
FWA	All	+	Increase in growth; higher production	Increase feed input
FWA: cage	Tr STr	–	Eutrophication and upwelling; mortality of stock	Better planning; sitting, conform to climate change, regular monitoring
MA/FWA; mollusc	Tem	–	Increase virulence of dormant pathogens	Monitoring to prevent animal and human health risks
Carnivorous finfish/shrimp*	All	–	Limitations on fishmeal and fish-oil supplies/price	Fishmeal and fish-oil replacement; new forms of feed management; shift to non-carnivorous commodities
Artificial propagation of species for the LFRT*	Tr STr	(+)	Coral reef destruction	Aquaculture will impact positively by reducing an external driver contributing to destruction and help conserve biodiversity
			Sea-level rise and other marine circulation changes	
Primarily in deltaic regions	All	+/–	Saltwater intrusion	Shift upstream stenohaline species – costly; new euryhaline species in old facilities
		+/–	Loss of agricultural land	Aquaculture provides alternative livelihoods: capacity building and infrastructure are required
Shellfish*	All	–	Increase in harmful algal blooms (HAB)	Mortality and increased human health risks by eating cultured molluscs
Habitat changes/loss	All	–	Indirect influence on estuarine aquaculture; and on seed availability	Integrated coastal management, ecosystem approach
			Ocean acidification	
Mollusc/seaweed culture	All	–	Impact on calcareous shell formation/deposition	biotechnology approaches
			Water stress (+ drought conditions, etc.)	
Pond culture	All	–	Limitations for abstraction	Improve efficacy of water usage; encourage non-consumptive water use aquaculture, e.g. CBF
Culture-based fisheries	All	–	Water retention period reduced	Use of fast-growing fish species; increase efficacy of water sharing with primary users, e.g. irrigation of rice paddy
Riverine cage culture	All	–	Availability of wild seed stocks reduced/period changed	Shift to artificially propagated seed; extra cost
			Extreme climatic events	
All forms; predominantly coastal areas	All	–	Destruction of facilities; loss of stock; loss of business; mass-scale escapes with the potential for impacts on biodiversity	Encourage uptake of individual/cluster insurance; improve design to minimize mass escapes; encourage use of indigenous species to minimize impacts on biodiversity

Notes: FWA = freshwater aquaculture; MA = marine aquaculture; Tr = tropical aquaculture; STr = subtropical aquaculture; Tem = temperate aquaculture; LFRT= live fish restaurant trade; CBF= culture-based fisheries.

* Instances where more than one climatic change element will be responsible for the change.

Source: De Silva and Soto, 2009.

Trade-offs in adaptation strategies may occur. For example, a desire to move towards clearly defined property rights may lead to a level of rigidity that would inhibit a "dynamic approach" for coping with the effects of climate change, such as fish migration. As always, management strategies will need to be robust and consider the whole of the system as much as possible. Similarly, the fishing industry may respond to decreases in productivity by increasing fishing effort, an adaptation measure that would probably exacerbate any existing overexploitation of fisheries.

In aquaculture, examples of public institution-driven initiatives include the implementation of an ecosystem approach to aquaculture (EAA), which calls for the integrated approaches to management, owing to the utilization of a common pool of resources such as water, land and feeds among multiple sectors. Coordinated watershed management is considered a key approach for climate change adaptation strategies in relation to land and water ecosystems, as conflict over the resource use may be fuelled where competence over watershed boundaries is not well established. Aquaculture adaptation also includes the prioritization and enhancement of mariculture, especially non-fed aquaculture (filter feeders, algae). This measure is particularly pertinent in sites affected by saline intrusion, close to coastal zones, where the shift to mariculture could also represent a novel business opportunity for the firms operating in these areas. Other types of adaptation measures (public/private) include: insurance activities; research and technology transfer; and aquaculture zoning and monitoring.

A wide range of adaptation measures specific to the fisheries and aquaculture subsectors can be identified (Tables 4 and 5), many of which may be considered robust responses as they improve resilience of the systems regardless of the driver of change.

3.4.2 Areas of NAPA adaptation priority activities linked to the fisheries and aquaculture sector

The NAPA formulation process has constituted a planning exercise for LDCs in the elaboration of adaptation strategies for vulnerable sectors. The consultations among institutions, experts and stakeholders, which were recommended in the NAPA preparation procedures, have led to the elaboration of 86 adaptation priority activities relevant to fisheries and aquaculture and CZME, which can be grouped into four areas of intervention. Table 6 lists the main areas of intervention and provides a description of the priority activities elaborated in the NAPAs. The table identifies how these areas of intervention link to the fisheries and aquaculture sector, either directly or indirectly through other NAPA sectors.

Table 6
Main areas of adaptation intervention within NAPAs

Area of intervention	FI/AQ	CZME	NAPA priority activities
Development/sector enhancement	x		Aquaculture development and improvement; mariculture; investment in marketing; enhanced post-harvest conservation techniques
Infrastructure		x	Mangroves reforestation; hard defences
Management	x	x	Lake ecosystem management; terrestrial ecosystem integrated management; integrated coastal zone management; fisheries resource sustainable management
Early warning/preparedness/ education	x	x	"Safer island strategy"; monitor and mapping; observatories; information dissemination; educational activities for stakeholders and target communities

Development

More than a dozen priority activities cover development-related issues as their main goal is to increase the productivity and the efficiency of the fisheries and aquaculture sector. Some of these activities target aquaculture (e.g. proposing the introduction of new techniques such as mariculture in Bangladesh); while others focus on post-harvest and marketing activities. The activities falling into the development area are expected to realize the following main outputs: (i) a more efficient fishing

environment within an empowered legal framework; (ii) the improvement and diversification of livelihoods; and (iii) the introduction of new market opportunities for fish products.

These types of priority activities, in particular, propose the setting up of income-generating or income-support strategies, the optimization of fisheries technologies and the development of new fish culture areas. A good example is Mauritania's priority activity "Protection of the diversity of the fish population and prevention of over-fishing with a view to sustainable development", whose activities range from the development of simple aquaculture techniques adapted to climate change contexts to preserve genetic diversity to the introduction of the climate change dimension into all programmes and strategies for the fishing sector.

Infrastructure

One of the main concerns for LDCs is SLR. Many NAPA priority activities recommend the adoption of measures to protect the coasts from SLR (countries: Bangladesh, Benin, Cambodia, Democratic Republic of the Congo, Djibouti, Guinea, Sao Tome and Principe, Senegal and Yemen). There are two main types of infrastructure activities: one (type) that encourages reforestation, by re-planting the vegetation (mangroves) along the coasts, in order to create buffer zones and reconstitute the natural coastal environment damaged by human activities;[15] and a second one that proposes the construction of hard defence barriers. This second adaptation measure may have adverse consequences for marine ecosystems. Where no other adaptation options are considered applicable, the construction of physical barriers should be carefully planned in light of the potential impacts on marine and coastal systems.

Management

Some NAPA priority activities focus on coastal zone management (integrated, sustainable, participative) or fisheries management. Not all these types of priority activities explicitly refer to management, but some of them encourage the formulation and implementation of activities to protect and improve the target ecosystems, usually advising the inclusion of climate change concerns into fisheries or marine and coastal planning. These types of activities generally require cooperation among multiple sectors in the ecosystem management.

Examples of "standard" management activities are Kiribati's "Coastal zone management and resilience enhancement for adaptation" or Cape Verde's "Integrated protection and management of coastal zones" priority activities.

Early warning/preparedness/education

This broad area of intervention encompasses activities aimed at both reducing risks related to natural disasters through monitoring and research and improving preparedness and response to disasters. For the part focused on prevention and disaster preparedness, early-warning-system improvements, contingency planning and monitoring activities are proposed, as well as targeted research on climate change and variability impacts on fisheries and marine resources. The activities concentrated on education and communication acknowledge the lack of information and awareness reported by the populations which results in incapacity to cope with and adapt to climate change adverse impacts.

Table 7 provides a count of priority areas relevant to the fisheries and aquaculture and CZME sectors.

Table 7
Priority areas concerning fisheries and aquaculture and CZME identified in NAPAs

Country	Number of NAPA priority activities		
	Relating to FI&AQ	Relating to CZME	Total PA in NAPA
Afghanistan	0	0	2
Angola	n.a.	n.a.	n.a.

[15] Additional, multiple benefits may be gained, such as increased fish production through the rehabilitation of aquatic systems.

Country	Number of NAPA priority activities		
	Relating to FI&AQ	Relating to CZME	Total PA in NAPA
Bangladesh	3	1	15
Benin	1	1	5
Bhutan	0	0	9
Burkina Faso	0	0	12
Burundi	1	0	12
Cambodia	2	1	20
Cape Verde	0	1	3
Central African Republic	0	0	10
Chad	3	0	10
Comoros	2	0	13
Democratic Republic of the Congo	0	1	3
Djibouti	0	2	8
Eritrea	0	0	5
Ethiopia	1	0	11
Equatorial Guinea	n.a.	n.a.	n.a.
Gambia	1	1	10
Guinea	3	2	25
Guinea-Bissau	2	3	14
Haiti	1	3	14
Kiribati	0	3	10
Lao People's Democratic Republic	0	0	12
Lesotho	0	0	11
Liberia	0	1	3
Madagascar	0	1	15
Malawi	2	0	5
Maldives	1	3	11
Mali	3	0	19
Mauritania	1	1	28
Myanmar	n.a.	n.a.	n.a.
Mozambique	3	1	4
Nepal	n.a.	n.a.	n.a.
Niger	2	0	14
Rwanda	0	0	7
Samoa	0	1	9
Sao Tome and Principe	4	0	22
Senegal	1	1	4
Sierra Leone	3	4	24
Solomon Islands	1	2	7
Somalia	n.a.	n.a.	n.a.
Sudan	1	0	5
Timor-Leste			n.a.
Togo	1	1	7
Vanuatu	1	0	5
Tuvalu	1	2	7
Uganda	0	0	9
United Republic of Tanzania	0	0	6
Yemen	1	2	12
Zambia	1	0	10
Total	47	39	467

Note: n.a. = not applicable as NAPA non-existing at time of report.

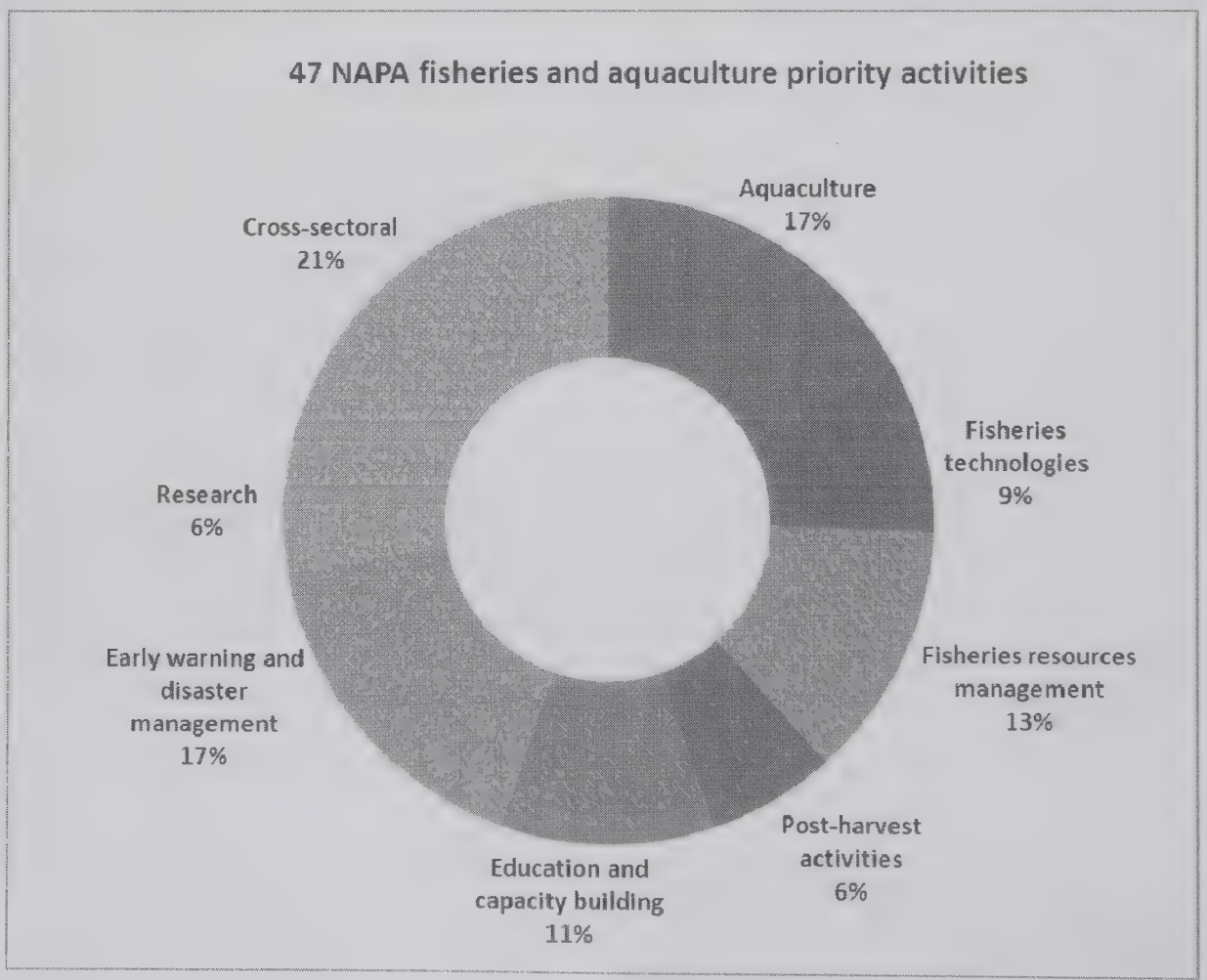
3.4.3 Review of fisheries and aquaculture sector-specific NAPA adaptation priority activities

Looking at the fisheries and aquaculture sector in more detail, the 47 priority activities explicitly targeting the fisheries and aquaculture sector can be grouped into eight broad typologies, according to the type of intervention (Figure 6):

- aquaculture;
- fisheries technologies;
- post-harvest activities;
- fisheries resources management;
- research;
- early warning and disaster preparedness;
- education and capacity building;
- cross-sectoral.

A detailed listing of NAPA-identified priority activities directly linked to the fisheries and aquaculture sector is presented in Annex 1.

Figure 6
Breakdown of fisheries and aquaculture sector-specific priority activities identified within NAPAs



Aquaculture *(eight NAPA priority activities in Bangladesh [2], Cambodia, Gambia, Guinea, Malawi, Mali and Zambia)*

One third of the fisheries and aquaculture sector-related NAPA priority activities focus on aquaculture. The land-locked countries of Malawi, Mali and Zambia have formulated priority activities that address aquaculture within an ecosystem approach that takes into consideration the natural terrestrial and aquatic and human systems.

Malawi's and **Zambia's** priority activities, titled "Integrated sustainable livelihood", show interesting similarities, being both aimed at ensuring food security through coordination among the agriculture, aquaculture and water management sectors, which are exposed to climate-related disasters, such as floods and droughts. The main goal of these adaptation activities is to build resilience for the ecosystems exposed to drought and other climate risks by improving water management and crop and livestock production (including aquaculture) through an integrated and participatory approach.

Bangladesh's two priority activities target aquaculture. One priority activity promotes mariculture, the culture of salt-tolerant fish species in coastal zones in order to face the rising salinity of waters and inward sea intrusion experienced in some areas over the past years. The priority activity, titled "Promoting adaptation to coastal fisheries through culture of salt tolerant fish species in coastal areas" has been identified through regional consultation workshops that have discussed the situation of coastal aquaculture farmers coping with increased flooding from the sea, in particular shrimp farmers. The culture of salt-tolerant fish would be developed in priority areas through pilot projects and adaptation strategies after an assessment of the extent and depth of saltwater intrusion in those areas.

The second Bangladeshi priority activity, adaptation to fisheries in areas prone to enhanced flooding in northeast and central region through adaptive and diversified fish culture practices, aims at reducing fish production losses in the aquaculture sector caused by increased inland flooding. Among diversified fish culture practices will be pen and cage culture of fish in floodplain areas during flood seasons.

Cambodia, through its priority activity "Development and improvement of small aquaculture ponds", recognizes the crucial role of small-scale aquaculture in supporting food security in the country's rural areas and encourages the introduction of sustainable aquaculture technologies. In addition, increasing aquaculture production is considered an option in response to the reduction in wild fish stocks caused by changes in water flows and levels. The development of aquaculture would also contribute to enhancing and diversifying rural livelihoods.

Mali's NAPA priority activity, "Rehabilitation of aquaculture sites", aims at improving the livelihoods of the communities practicing small-scale aquaculture. It is part of a wider programme of development of agriculture and aquaculture in the country. The aquaculture activities will help generate new income opportunities for the local communities. New ponds will be developed and the water system will be sustainably managed with the involvement of the local population.

Guinea combines two objectives in one priority activity: increasing oyster production and protecting mangrove ecosystems. The current oyster production causes damage to the mangrove vegetation, as the mangrove roots where the oyster population grows are cut in order to extract the oysters, leading to a reduction in the number of mangrove trees. The adaptation activity aims at training the coastal communities in new techniques for oysters extraction.

Gambia's "Increasing fish production through aquaculture and conservation of post harvest fishery products" priority activity is directed to ensuring the food security of rural communities by the empowerment of the aquaculture sector both in the production phase, through targeted interventions on infrastructure and the technical capacities, and in the post-production phase, through improving processing and storage techniques.

Fisheries technologies *(four NAPA priority activities in Comoros, Maldives, and Sao Tome and Principe [2])*

Four NAPA priority activities target fishing techniques with the goal of maximizing the economic returns from the fisheries activities as well as training fishers in safer fishing techniques under unstable climatic conditions. All these activities are formulated by small island countries: the Comoros, Maldives and Sao Tome and Principe.

The **Comoros** proposes the "Introduction of fish concentration mechanisms" (FCMs)[16] with the aim of increasing fish availability under chronic shortages of fish, which is aggravated by climate instability. **Sao Tome and Principe** has also elaborated priority activities focused on fish concentration devices, in order to protect fishers lives from the risks connected to windstorms and intense fog, through reducing the extension of the fishing zone.

The priority activity of **Maldives** on alternative live bait management, catch and holding techniques for the tuna fishery sector, is formulated in response to the decline in abundance of live bait for tuna fishing owing to overexploitation and coral bleaching. It aims at reducing fish bait vulnerability to predicted sea surface temperature changes and at exploring alternative techniques of live bait. In Maldives, the tuna fishery contributes more than 7 percent to its GDP.

Post-harvest sector improvements *(three NAPA priority activities in Comoros, Guinea and Togo)*

The **Comoros** and **Togo** have formulated two NAPA priority activities on post-harvest activities. The **Comoros** priority activity entitled "Short conservation of fish under ice" suggests the improvement of post-harvest techniques for storage, as rising air temperatures cause the deterioration of catches. **Togo**'s priority activity main objective is to set up income-generating activities for the fishers' communities through the provision of professional training activities, the improvement of the processing techniques and the marketing of fish products.

Guinea has elaborated the priority activity "Promoting the use of solar energy for fish drying to reduce pressure on mangroves" mainly to arrest the deforestation across the country. The smoking of fish through burning mangrove and other types of trees has contributed to a reduction in the mangrove vegetation in some peripheral areas of the country. Solar energy can be a substitute for smoke for the drying of fish, as it is economically sustainable and ensures the preservation of the nutritional value of fish.

Management of the fisheries resources *(six NAPA priority activities in Guinea, Guinea-Bissau, Mauritania, Tuvalu, Vanuatu and Yemen)*

Six NAPA priority activities address the protection of the fish resource as a means of increasing resilience. In many cases, they suggest the adoption of sustainable management for the fish resources.

Guinea's priority activity "Protection of spawning areas in Fatale, Konkoure and Mellacore estuaries" targets the estuary zones vital for the reproduction of fish and shellfish that have been damaged by uncontrolled fishing and mangrove deforestation. It recommends the adoption of sustainable management in order to safeguard the health of the coastal estuaries zones, which constitute the nursery habitat for many fish species, molluscs and crustaceans.

Mauritania's priority activity "Protection of the diversity of the fish population and prevention of over-fishing with a view to sustainable development" has three main objectives: (i) ensure the establishment of rules that take into consideration the well-being of the fish resource in coastal development planning; (ii) promote genetic diversity of fish populations through aquaculture; and (iii) extend monitoring of the resource to the whole exclusive economic zone.

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[16] Fish concentration mechanisms, fish concentration devices or fish aggregation devices may adversely affect the fish resource. There is no scientific agreement on the advantages of such fishing instruments over their negative impacts (bycatch).

Guinea-Bissau's priority activity "Protection, conservation and enhancement of fishing and coastal resources project" addresses comanagement of the fishing resources in order to improve the fisheries sector revenues to the benefit of the local population. The NAPA activity intends to realize a durable institutional mechanism for conflict mediation and a fishing-surveillance system within a framework of sustainable use of the fisheries resource.

Tuvalu's priority activity "Adaptation to coastal shellfish fisheries resources productivity by highlighting the importance of shellfish as one of the most accessible protein source of food for the population" focuses on the urgency to protect the nearshore shellfish resources and coral reef ecosystems. Stress to the coral reef ecosystems of the islands is caused by increasing sea surface temperatures and human harvesting activities.

Yemen addresses sustainable management in its NAPA priority activity "Sustainable management of fisheries resources", which aims to include the well-being of the fish resources and their habitats into marine and coastal planning and regulation. Other objectives of Yemen's priority activity are to support the income of fishers and to enhance the sector by improving the post-harvest and marketing operations.

Vanuatu's "Community-based marine resource management programmes" has three main objectives: (i) increase the adaptive capacity of coastal communities to climate change, through pilot projects implemented in vulnerable islands; (ii) integrate adaptation into policies and programmes; and (iii) develop community-based management programmes for marine resources that take into account climate change concerns and sustainable use of the fisheries resource.

Research *(three NAPA priority activities in Sierra Leone [2] and Solomon Islands)*

Sierra Leone addresses research on the fisheries sector, as its NAPA document acknowledges that the country suffers a substantial lack of scientific information on fisheries-related data. Two priority activities are therefore elaborated that aim at filling such a gap, one is the "Establishment of a permanent study programme of the multi species fisheries in Sierra Leone" and the other is "Improvement on the quality on fisheries related data and research".

As the fisheries resources are one of the main food and economic assets of **Solomon Islands**, the country has elaborated an NAPA activity that focuses on the health of such resources. The priority activity "Improve the understanding of the effects of climate change and climate variability including El Nino-Southern Oscillation on the inshore and tuna fishery resources" aims at developing an efficient monitoring system for and disseminating information about the impacts of climate change on the fisheries resources. Raising awareness will allow for better protection of the marine habitats and the promotion of sustainable fisheries technologies.

Early warning *(eight NAPA priority activities in Benin, Chad [2], Guinea-Bissau, Malawi, Mozambique, and Sao Tome and Principe [2])*

The floods, drought and sea intrusion that affect **Benin**, particularly in the far north, the west, the cotton areas of the centre, and the fishing zones, could be better tackled by the vulnerable population in the presence of an efficient alert system. The NAPA priority activity "Establishment of an early warning system for climatic risks and for food security in four vulnerable agroecologic zones" employs resources in building an early warning system that can provide accurate information on imminent climate-related events that threaten vital natural assets for rural populations and their food security. Alongside the establishment of an alert system, the NAPA activity promotes production systems that can adapt to climate change.

Chad has elaborated two NAPA priority activities that cover the fisheries sector as these address early warning systems on weather events and building preparedness to potential climate change impacts: (i) improvement in quality of seasonal forecasts for rainfall and surface water flows and their integration into an overall strategy for vulnerability; and (ii) reduction of the climate-change-related vulnerability of the populations/management of climate change risks. These priority activities aim to enhance the

quality of forecasting, improve the communication and information flows and strengthen the national strategy on risk management in relation to climate change. The sectors involved are agriculture, fisheries and aquaculture, as the majority of the population lives in rural areas and depends on natural resources highly exposed to changes in weather conditions.

Guinea-Bissau's "Natural catastrophe prevention" priority activity has three main objectives: (i) establish a national meteorological centre; (ii) sensitize the population to climate risks; and (iii) improve meteorological and hydrological forecasting. Fishers are among the beneficiaries of an efficient and reliable meteorological system.

Malawi has formulated one priority activity on early warning in order to improve the sustainable utilization of Lake Malawi and the lakeshore area through undertaking climate monitoring activities. Other aims of the activity are to strengthen disaster preparedness for rural fishing and aquaculture communities and to enhance the adaptive capacity of riparian communities.

The need for an improved early warning system is the rationale behind **Mozambique**'s priority activity "Strengthening of an early warning system". The country has an extensive network of pluviometric stations but they are not standardized; therefore, the NAPA activity will fill this gap. Another objective of the activity is to improve coordination among sectors on information dissemination and effective communication on climate-related hazardous events.

Fishers are the main beneficiaries of **Sao Tome and Principe**'s priority activity "Establishment of a system of climate alert", by the provision of accurate forecasting on weather conditions before starting their work at sea. The NAPA activity, through the rehabilitation of the national meteorological system, seeks to prevent loss of human life and improve the response to natural disasters linked to climate change and variability. Sao Tome and Principe's priority activity "Construction of infrastructure for the protection of the coastal vulnerable communities" also targets fishers communities. The construction of harbours, bridges and protection barriers as well as recovering canoe parks in fishing communities aim to rebuild fisheries infrastructure and equipment greatly damaged by windstorms.

Education and capacity building *(five NAPA priority activities in Bangladesh, Chad, Mozambique, Senegal and the Sudan)*

The priority activity on capacity building for integrating climate change in planning, designing of infrastructure, conflict management and land–water zoning for water management institutions is designed by **Bangladesh** principally to resolve conflicts over water resource management. The management and use of water is shared among different actors (fishers, farmers, etc.), and the absence of regulation has often led to tensions, in particular farmers have been complaining about drainage of the water resource by fishers. Therefore, there is a need for planning sustainable management of the water resources and building capacity on conflict management. Land and water zoning for the sustainable use of resources will be applied. Climate change impacts on the water resource will be studied in order to develop adaptation strategies.

Fishers are among the beneficiaries of the "Improvement of information, education and communication for adaptation to climate change" in **Chad**'s priority activity, as consultations during the NAPA's formulation process showed that the rural population suffers from a lack of information on climate change impacts and coping strategies. The information campaign should lead to a better understanding of the climate risks by various actors (rural population, policy-makers) and, as a result, adaptation measures will be formulated.

In order to minimize climate change impacts on the agriculture sector, **Mozambique**'s "Strengthening capacities of agricultural producers to deal with climate change" priority activity promotes the development of new drilling systems and small-scale irrigation systems, the use of renewable energy and the practice of activities like aquaculture. It also financially supports small-scale business and encourages the creation of associations among farmers and fishers.

Senegal's priority activity "Education and warning campaign" will develop a communication campaign on climate change impacts. In addition, professionals from the agriculture, fisheries, tourism, water and health sectors will take part in technical and scientific round tables on climate change, and climate change will be streamlined into sectoral policies and national development policies.

The priority activity "Strategies to adapt to drought induced water shortages in highly vulnerable areas in Central Equatorial State" in the **Sudan** addresses the problem of water shortage caused by drought in highly vulnerable areas in the southern equatorial state. Along with the objective of improving the water supply, by building new microcatchments, dams and wells, and planning a sustainable use of the water resources, the activity promotes the introduction of new fish species for higher protein intake and income generation, as the population suffers from food scarcity owing to climate and human factors (the recent armed conflict) and poverty.

Cross-sectoral *(ten NAPA priority activities in Burundi, Cambodia, Ethiopia, Haiti, Mali [2], Mozambique, Niger [2] and Sierra Leone)*

Burundi's priority activity "Protection of the buffer zones in Lake Tanganyika floodplain and around the lakes of Bugesera" sets as one of its long-term expected outputs the increase in the biodiversity and the fish resources of Lake Tanganyika and the marshes of Bugesera, establishing a new set of rules for the management of those aquatic systems, including surveillance on the use of waters for agriculture and livestock practices.

Cambodia's priority activity "Rehabilitation of Upper Mekong and provincial waterways" focuses on water management; at the same time, great attention is paid to the fisheries resources. Besides realizing infrastructure that reduces the risks linked to Mekong floods, the NAPA activity is also concerned with the maintenance of the fisheries resources and increasing fisheries production levels.

Ethiopia's priority activity "Community-based sustainable utilization and management of wetlands in selected parts of Ethiopia" embraces multiple sectors as it is aimed at the sustainable management of wetlands, with the goal of combating desertification, preserving biodiversity and preparing the local communities to adaptation to climate change. The health of fisheries is directly linked to the aquatic ecosystems condition in the wetlands areas.

Haiti's priority activity "Reduction of inundations and improvement of agricultural conditions for the management of the North-West and North-East Basins" addresses the problems of desertification and the coastal erosion in the north of the country. In particular, the sediments developing along the coast have negative impacts on the fisheries activities. Among the outputs of the NAPA activity are: vegetation reintroduced on deforested areas; and population aware of, and trained to cope with, climate change impacts.

The main objective of **Mali**'s priority activity "Implementation of a run-off water harvesting system and restoration of water points (backwater, ponds and lakes)" is to ensure food security through improved water management in the rural areas, which leads to an increase in productivity in the agriculture, farming and fisheries sectors. Another priority activity, "Implementation of drilling equipped with solar- or wind-driven systems", includes the realization of fisheries and aquaculture activities among its objectives. The NAPA activity addresses the needs for more water supply in the north of the country, which could be satisfied through the implementation new drilling technologies.

Mozambique's priority activity "Management of water resources under the climate change framework" is focused on the water resources sector, which is highly affected by climate-generated events like floods, drought and saline intrusion. In particular, floods cause the interruption of several activities in different sectors, including fisheries. The NAPA activity promotes the improvement of the monitoring system on the river water levels and the development a more accurate forecasting system in order to avoid the damage caused by floods in the country's hydrological basins.

Niger has elaborated two priority activities that cross the fisheries sector, one of them concentrated on the water resources sector and the other on the terrestrial ecosystem. The priority activity "Water control: mobilization of surface water and exploitation of ground water" has the goal of improving agricultural production (and fisheries) through better control of surface water and a more efficient use of underground waters. The NAPA activity also promotes the development of fisheries activities. The priority activity "Protection of riversides and restoration of silted up ponds" focuses on two districts affected by adverse climate impacts, particularly with regard to watercourses and silted-up ponds. The rehabilitation of the aquatic ecosystems of these areas will allow for a more productive use of water by the local population, with benefits for the agricultural, fisheries and farming activities.

The main objectives of **Sierra Leone**'s priority activity "Delineation and restoration of vulnerable habitats and ecosystems in the Western area of Sierra Leone" are to prevent the destruction of vulnerable fishing habitat and to reduce the decline in fishery productivity. The drying out of spawning areas like ponds and inland waterbodies during dry seasons leads to a decrease in the fish populations.

3.4.4 Review of coastal zones and marine ecosystems NAPA adaptation priority activities indirectly linked to the fisheries and aquaculture sector

In addition to the sectoral and cross-sectoral projects explicitly targeting the fisheries and aquaculture sector mentioned above, it is also important to identify other UNFCCC sectors in which the fisheries and aquaculture sector may or may not be specifically mentioned but could either benefit from or be affected by these other sectors' adaptation activities. These proposals, therefore, potentially merit the inclusion of the sector in any adaptation projects stemming from the identified priority activities. This section provides a brief review of 39 priority activities within the coastal zones and marine ecosystems (CZME) sector as an example; noting that other UNFCCC sectors, such as freshwater resources and food security, also merit the attention of the fisheries and aquaculture sector in order to benefit from vulnerability reduction activities and to minimize unintended negative downstream impacts the sector may incur. This is especially the case for inland fisheries and aquaculture-dependent communities.

Owing to their particular vulnerability to SLR, two-thirds of the small island developing States (SIDS) proposed priority activities focusing on CZME. Exceptions to this included Vanuatu and the Comoros.[17] Of the 24 countries proposing priority activities in the CZME sectors, almost half[18] (13) of these reported high population densities in coastal areas (e.g. from 80 to 100 percent of their populations living within 100 km of the coast).

The 39 priority activities targeting CZME identified in the NAPAs can be grouped into eight typologies (Figure 7):

- coastal zone management (CZM);
- conservation within CZME;
- early warning and disaster preparedness within CZME;
- education and capacity building within CZME;
- infrastructure within CZME;
- reforestation with CZME;
- research within CZME;
- other.

A listing of NAPA-identified priority activities indirectly linked to the fisheries and aquaculture sector through the CZME sector is presented in Annex 2.

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[17] However, the Comoros has implemented a regional project for the integrated management of the coastal zone, the Regional Environment Project of the Indian Ocean Commission between 1995 and 2000, but the coastal sector is not included in the list of most vulnerable sectors provided in its NAPA.

[18] Such information was missing for Samoa and Sao Tome and Principe, which are SIDS.

Table 8

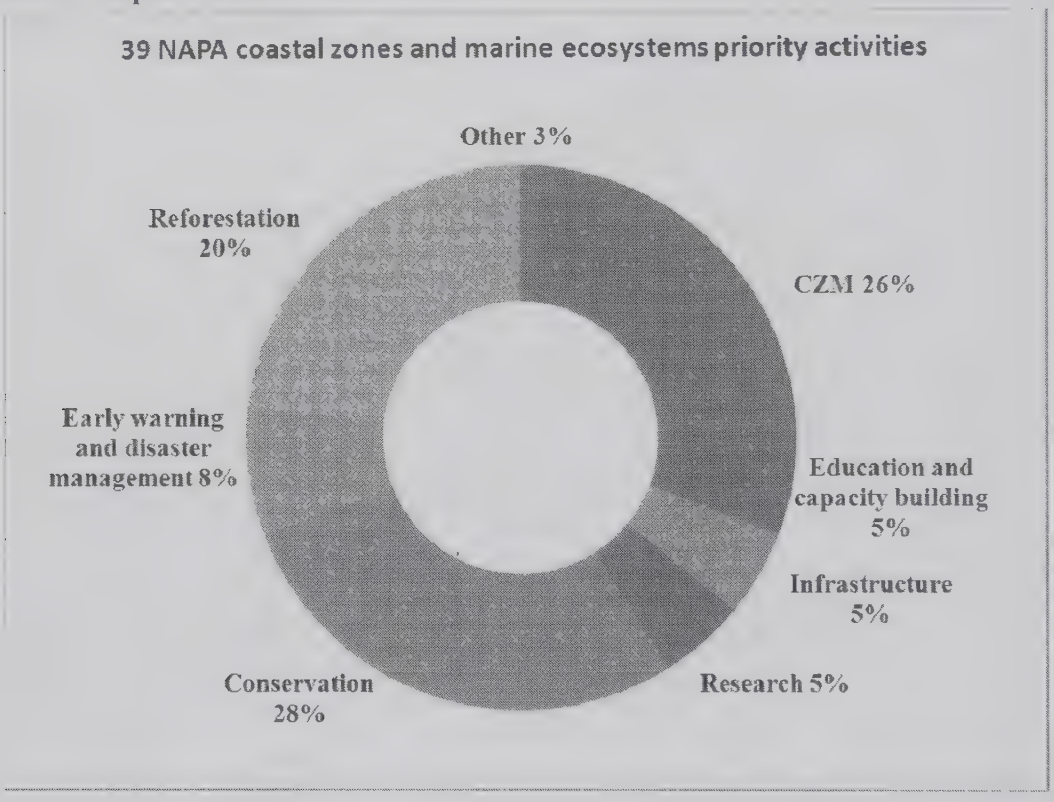
Listing of coastal zones and marine ecosystems (CZME) NAPA priority activities relevant to the fisheries and aquaculture sector

Country	World region	Small island developing State	Inclusion of CZME sector in NAPA context definition	Number of CZME-related NAPA priority activities
Afghanistan	Asia		No	0
Angola	Sub-Saharan Africa		No NAPA	0
Bangladesh	Asia		Level 1	1
Benin	Sub-Saharan Africa		Level 3	1
Bhutan	Asia		No	0
Burkina Faso	Sub-Saharan Africa		No	0
Burundi	Sub-Saharan Africa		No	0
Cambodia	Asia		Level 2	1
Cape Verde	Sub-Saharan Africa	X	Level 3	1
Central African Republic	Sub-Saharan Africa		No	0
Chad	Sub-Saharan Africa		No	0
Democratic Republic of the Congo	Sub-Saharan Africa		Level 1	1
Djibouti	Sub-Saharan Africa		Level 2	2
Equatorial Guinea	Sub-Saharan Africa		No NAPA	0
Eritrea	Sub-Saharan Africa		Level 3	0
Ethiopia	Sub-Saharan Africa		No	0
Gambia	Sub-Saharan Africa		Level 3	1
Guinea	Sub-Saharan Africa		Level 1	2
Guinea-Bissau	Sub-Saharan Africa		Level 3	3
Haiti	Caribbean	X	Level 2	3
Kiribati	Pacific	X	Level 3	3
Lao People's Democratic Republic	Asia		No	0
Lesotho	Sub-Saharan Africa		No	0
Liberia	Sub-Saharan Africa		Level 1	1
Madagascar	Sub-Saharan Africa		Level 3	1
Malawi	Sub-Saharan Africa		No	0
Maldives	Asia	X	Level 3	4
Mali	Sub-Saharan Africa		No	0
Mauritania	Sub-Saharan Africa		Level 3	1
Mozambique	Sub-Saharan Africa		Level 2	1
Myanmar	Asia		No NAPA	0
Nepal	Asia		No	0
Niger	Sub-Saharan Africa		No	0
Rwanda	Sub-Saharan Africa		No	0
Samoa	Pacific	X	Level 3	1
Sao Tome and Principe	Sub-Saharan Africa	X	Level 2	0
Senegal	Sub-Saharan Africa		Level 3	1
Sierra Leone	Sub-Saharan Africa		Level 3	4
Solomon Islands	Pacific	X	Level 3	1
Somalia	Sub-Saharan Africa		No NAPA	0
Sudan	Sub-Saharan Africa		No	0
Timor-Leste	Asia		No NAPA	0
Togo	Sub-Saharan Africa		Level 3	1
Tuvalu	Pacific	X	Level 3	2
Uganda	Sub-Saharan Africa		No	0

Country	World region	Small island developing State	Inclusion of CZME sector in NAPA context definition	Number of CZME-related NAPA priority activities
United Republic of Tanzania	Sub-Saharan Africa		Level 3	0
Vanuatu	Pacific		Level 3	0
Yemen	Middle East		Level 2	2
Zambia	Sub-Saharan Africa		Level 2	2

Notes: level 1 = mentioned; level 2 = elaborated; level 3 = stressed upon.

Figure 7
Breakdown of coastal zones and marine ecosystem priority (CZME) activities with direct links to fisheries and aquaculture



Coastal zone management *(ten NAPA priority activities in Cape Verde, Djibouti, the Gambia, Kiribati, Maldives, Mozambique, Sierra Leone [2], Solomon Islands and Yemen)*

Ten NAPA priority activities propose the establishment or the improvement of CZM policies and plans. Some of them explicitly refer to CZM, while others recommend the establishment of integrated regulatory frameworks together with a range of activities (educational, awareness-raising, preservation) for adaptation to climate change impacts.

Cape Verde's "Integrated protection and management of coastal zones" priority activity address the exposure of the coastal zones to SLR and saline intrusion, as well as human activities that affect the health of the coastal natural habitats, such as illegal extraction of sand and rock material. The NAPA activity proposes the adoption of an integrated management plan based on four components: (i) reinforcement of stakeholder's capacities on adaptation to climate change and variability; (ii) investment in conservation activities; (iii) research on extraction of inert material in order to find adequate alternatives; and (iv) establishment of an early warning system for potential upcoming calamities.

Djibouti has elaborated one priority activity titled "Mitigation of climate change related risks for the production system of coastal areas through an integrated, adapted and participatory management" that involves grassroots organizations and has the following objectives: the regeneration of the mangroves; the improvement of the community capacities for water provision and the improvement of agricultural practices; and the diversification of subsistence activities for local communities.

The main objectives of the **Gambia**'s priority activity "Restoration/protection of coastal environments" are the improvement of integrated coastal zone management (ICZM) and the protection of the physical infrastructure located along the coast. Target areas are the livelihoods of the coastal communities and the coastal and marine ecosystems.

Kiribati's "Coastal zone management and resilience for adaptation" priority activity addresses the coastal erosion phenomenon and promotes the establishment of pilot, community-based, coastal management regimes and increased community participation in coastal and marine ecosystem management programmes. The coastal communities are also encouraged to develop their own small-scale projects. Another component of the priority activity is the streamlining of the regulatory policies and monitoring activities in order to guarantee the sustainable use of the marine and coastal resources.

Following the Indian Ocean tsunami of 2004, **Maldives** developed the Safer Island Strategy (SIS) to resettle communities from the smaller and more vulnerable islands onto larger and better protected ones. Initial risk assessments of some of the safer islands have stressed the need for more research focused on coastal engineering and for the formulation of appropriate adaptation measures. Within the framework of the SIS, the NAPA activity "Coastal protection of safer islands to reduce the risk from sea induced flooding and predicted sea level rise" undertakes technical and engineering studies on coastal protection and adaptation measures for five pilot safer islands. Based on the findings of the studies, a pilot coastal protection measure for one safer island will be implemented.

According to the country's NAPA, marine and coastal ecosystems in **Mozambique** have been heavily affected by human activities, with negative consequences on the marine resources. In addition, coastal erosion has reached critical stages. The NAPA priority action "Reduction of the impact of climate change in coastal zones" proposes the adoption of coastal integrated management and focuses on the rehabilitation of dunes and mangroves and on building adaptive capacity for local communities through their active participation in the ecosystem management mechanisms and the development of ad hoc legislation.

Sierra Leone has formulated two CZM priority activities. The priority activity "Development of an integrated coastal zone management plan" addresses the country's policy on coastal management strategies and envisages integrated CZM planning as the most appropriate approach to managing the coastal and marine environments. The priority activity "Develop and enact appropriate policies and regulations relevant to the development of coastal communities, urban growth planning, and critical coastal ecosystems preservation" is aimed at the development of an integrated policy and legislative framework for coastal and marine ecosystems among all involved sectors (agriculture, forestry, fisheries, urban planning), as the lack of synergy among these has led to conflicts. The new policies should provide guidelines to institutions working on coastal-ecosystem-related areas and identify common goals for the preservation of the health of the coastal and marine environments.

Solomon Islands, through the implementation of integrated coastal zone management (ICZM), seek to promote sustainable development in the coastal areas while integrating climate change adaptation into infrastructure development plans and protection programmes for foreshore vegetation, lagoon and coral reefs.

Yemen's priority activity "Develop and implement Integrated Coastal Zone Management (ICZM)" targets four areas in the Red and Arabian Seas for the development and implementation of integrated management plans based on assessments of vulnerable habitats owing to climate change impacts and human degradation.

Conservation *(11 NAPA priority activities in the Democratic Republic of the Congo, Djibouti, Guinea, Haiti [3], Kiribati, Mauritania, Samoa, Sierra Leone and Tuvalu)*

The **Democratic Republic of the Congo**'s priority activity "Biodiversity conservation and restoration of Mangroves Marine Park" along with the development of a conservation strategy and a sustainable management of the natural resources of the Mangroves Marine Park aims to address the needs of the local communities, supporting, at the technical and financial level, the fishers and farming associations, as fisheries and agriculture are the main sources of livelihood for the population living in the area of the park. Women will be the beneficiaries of training courses on improved fish salting techniques.

Djibouti's "Restoration of protected sites through the protection of coral reefs and mangrove vegetation" priority activity targets the coastal ecosystem of the site of Doraleh, where the mangrove vegetation has been reduced to critical levels owing to the expansion of urban settlements and port infrastructures. Mangroves constitute a preferential site for fish spawning and for fishing activities for the local community. The NAPA priority activity recommends the implementation of the legislation on marine protected areas (MPAs) and the restoration of mangrove vegetation.

The reintroduction of the mangrove forest and the construction of protective sea walls are measures envisaged in the **Guinea**'s priority activity "Protection of cultivated areas neighbouring the coast" to address coastal erosion and saline intrusion. The global objective of the NAPA activity is to improve the productivity of the coastal soil as a means of contributing to the country's food security.

Haiti has formulated three priority activities concerned with the biodiversity of the marine and coastal ecosystems as part of an adaptation strategy in response to SLR and the degradation of the coastal ecosystems, including the destruction of mangroves. The activities target three different sites but have common objectives. Among these are: the protection of the biodiversity of the coastal and marine habitats, through a participated approach including the relevant agencies, the stakeholders and the coastal communities; and the reforestation of coastal areas and the improvement of the coastal infrastructure to prevent SLR. One of the priority activities addresses education and capacity building for small-scale fishers, instructing them on recommended fisheries periods and techniques to minimize their risks relating to cyclones.

Kiribati's "Coral reef restoration, monitoring and stock enhancement" priority activity is focused on the health of coral reefs, which contributes to the productivity of artisanal fisheries. Coral bleaching has been observed among some coral patches, and coastal village communities have experienced a drop in the availability of the fisheries resource. The main objectives of the NAPA activity are: to establish a monitoring programme for two atolls; to pilot a restoration scheme for coral species in areas of low growth; to conduct research on coral bleaching; to establish MPAs; and to set up a stock enhancement project.

Mauritania's priority activity "The protection and reinforcement of the dune bar along the coastline in Nouakchott" addresses the degradation of a coastal dune bar, considered the only natural barrier against sea storms in the capital Nouakchott. It proposes the establishment of a supervisory committee for the protection of the dune bar, the reforestation of the coastline, and the raising of awareness among the population on the risks connected with the deterioration of the sand dunes.

Samoa's "Establishing conservation programs in highly vulnerable marine and terrestrial areas of community projects" priority activity is aimed at preserving the biodiversity of marine and terrestrial ecosystems through comanagement between communities and responsible agencies. In order to safeguard the health of marine resources, especially corals, highly affected by coral bleaching, priority conservation areas will be established, and a community-based management plan will be developed.

Sierra Leone's priority activity "Rehabilitation of degraded coastal habitats in the Northern Region of Sierra Leone" addresses the degradation of the coastal habitats in the Northern Region provoked by human activities, such as deforestation, sand mining and construction activities, and by natural phenomena, such as sea salt intrusion and soil erosion. The NAPA activity main objectives are: the restoration of the ecological integrity of coastal habitats; the restoration of the source of livelihood for coastal dwellers; and the enforcement of coastal management in order to halt coastal degradation. Tree nurseries will be set up and managed by local communities.

Tuvalu's "Strengthening of community based conservation programmes on highly vulnerable near-shore marine ecosystems" priority activity has three main components: the development of a community sustainable marine management plan; the identification of priority conservation areas for each island; and the enhancement of community participation in marine resource conservation through integration of traditional and modern conservation practices.

Early warning/monitoring of impacts *(three NAPA priority activities in Guinea-Bissau [2] and Sierra Leone)*

With the priority activity "Coastal-areas erosion monitoring project", **Guinea-Bissau** focuses on exploring the causes of, and searching for suitable adaptation measures to, coastal erosion, including the development of a database on and the implementation of a monitoring system for such phenomena. A second NAPA priority activity in Guinea-Bissau, the "Observatory for mangroves monitoring and evaluation project", aims at collecting information to be employed for assessments of projects and strategies that concern mangrove ecosystems, with the goal of preserving these strategic natural resources.

Sierra Leone proposes the "Establishment of a national sea-level observing system" among its priority activities, as the country has experienced SLR that has contributed to the degradation of coastal resources and conflicts over the use of coastal resources. In addition, information on sea-level fluctuations would support safe navigation of vessels in and out of the main ports and assist in coastal planning.

Education *(two NAPA priority activities in Guinea and Guinea-Bissau)*

Guinea's priority activity "Promotion of environmental education for coastal communities" recognizes the importance of education for preserving the health of the marine ecosystem. Through dissemination of information, strengthened communication on policies and laws, socio-economic surveys, identification and implementation of pilot projects on alternative remunerative activities and other education activities, it pursues the objectives of reducing coastal erosion, promoting a change in the management of the coastal ecosystems and improving the livelihoods of the target population.

Guinea-Bissau's priority activity, "Environmental education and communication in coastal areas project", is formulated with the goal of raising awareness about the impacts of unsustainable practices on the coastal ecosystem and how they affect the coastal zone's sensitivity to climate change. It has two main objectives: (i) to strengthen the technical capacities and competences of target groups in climate change adaptation through natural resource management and biodiversity conservation activities; and (ii) to use radio as a means of promoting awareness about the role of sustainable management of resources and biodiversity for adaptation to climate change.

Infrastructure *(two NAPA priority activities in Kiribati and Liberia)*

Four NAPA priority activities address, primarily, hard infrastructure to protect the coastal areas against, *inter alia*, erosion, SLR, floods and storms. As mentioned above, special attention is needed to understand the impacts on the coastal systems, both human and aquatic, of hard infrastructure investments in order to minimize the risk of increasing vulnerability of non-target sectors.

Kiribati's priority activity "Upgrading, restoring, enhancing resilience of coastal defense and causeways" targets SLR through the upgrading of existing seawalls and the construction of causeways to improve accessibility within the atolls.

Liberia, with the priority activity "Coastal defense system for the cities of Buchanan and Monrovia", aims at restoring and maintaining the well-being of the coastal urban environments in Buchanan and Monrovia by controlling the alteration of the natural river systems of the sites and arresting beach erosion. The expected outputs are: a planning scheme for coastal and urban growth; the improved use of coastal resources (e.g. sand and gravel); increased socio-economic potential; and the implementation of measures to protect beach areas from erosion.

Reforestation *(eight NAPA priority activities in Bangladesh, Benin, Cambodia, Madagascar, Mauritania, Senegal, Togo, Tuvalu and Yemen)*

Reforestation is one of the most recurrent adaptation measures pursued by LDCs to stop coastal erosion and mitigate the effects of sea intrusion inland. Reforestation is also considered by many LDCs as the most suitable option for protecting the coast against SLR and is considered a measure that greatly contributes to preserving marine ecosystems as well helping coastal communities build resilience to adverse climate change impacts. As the reforestation NAPA activities have many similarities and are all concentrated principally on mangrove and trees replanting and protection, only the following project is described, summarizing the prevailing types of intervention.

Yemen's priority activity "Planting and re-planting of mangroves and palms for adaptation to sea level rise" aims to enhance the adaptive capacity of the coastal ecosystems through restoration and conservation of mangrove forests. It recommends the implementation of measures to preserve the sand dunes, together with the establishment of green belts and buffer zones through mangroves and palms re-planting and the rehabilitation of wetlands and degraded sand dunes.

Research *(two NAPA priority activities in Maldives)*

In its NAPA, **Maldives** has formulated two research-based priority activities. The first, "Increase resilience of coral reefs to reduce the vulnerability of islands, communities and reef dependant economic activities to predicted climate change", aims at increasing understanding on how coral reefs and islands naturally adapt to climate change and the role of human-induced stresses on coral reef resilience. The second priority activity, "Integration of future climate change scenarios in the safer island strategy to adapt sea level rise and extreme weather risks associated with climate change", aims to integrate climate change impacts and vulnerabilities into existing disaster risk assessments of nine safer islands, and will expand coverage of risk and vulnerability assessments to an additional five safer islands. Based on these assessments, the project will develop a vulnerability reduction and adaptation plan.

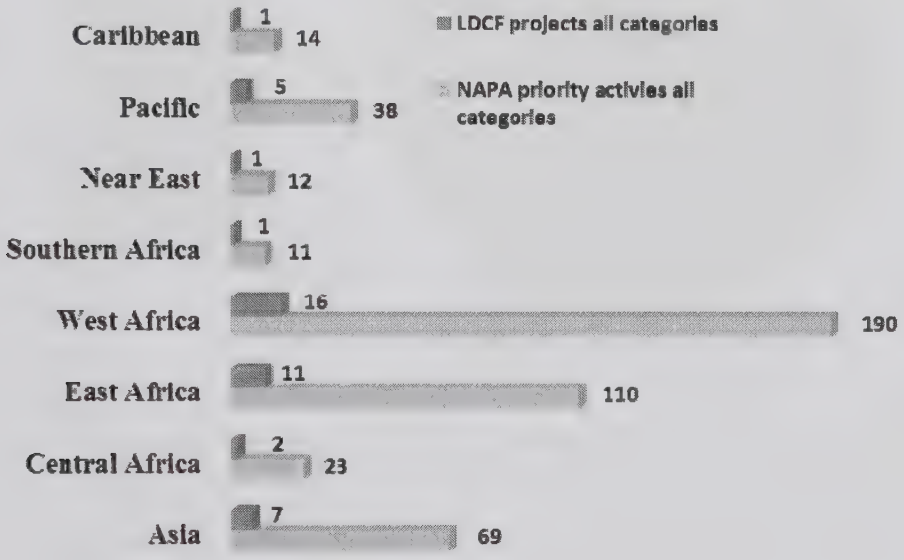
Other *(one NAPA priority activity in Maldives)*

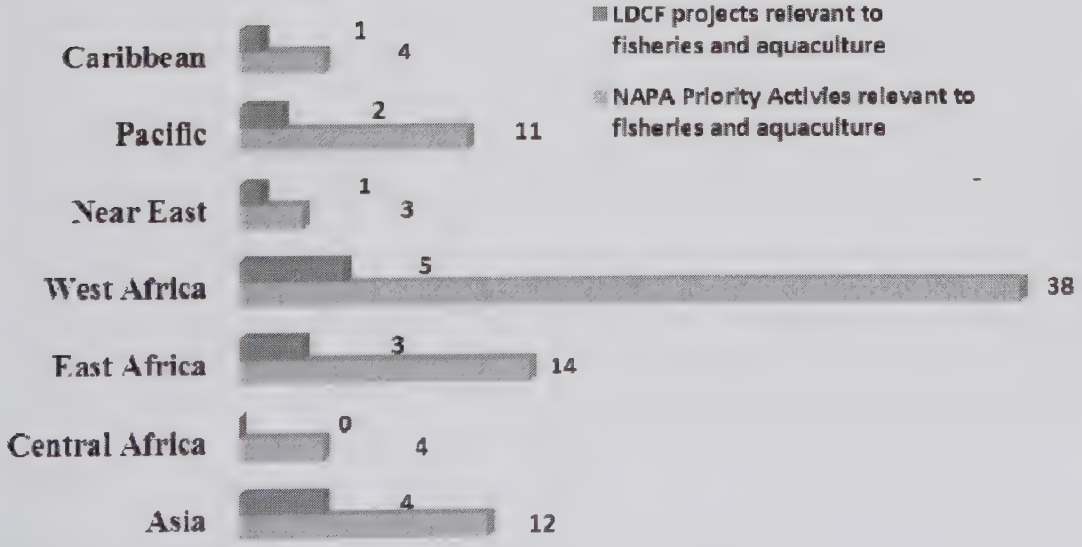
The 2006 Indian Ocean tsunami caused the destruction of poorly built-up sewerage systems in the affected islands of **Maldives**, which led to contamination and provoked consequent health problems. With concern to the risks connected to inappropriate treatment and disposal of wastewater, Maldives' priority activity "Enhance adaptive capacity to manage climate change related risks to fresh water availability by appropriate wastewater treatment technologies" has the objectives of identifying innovative and adequate wastewater treatment and disposal systems and educating communities on appropriate wastewater treatment. Fisheries will be among the multiple sectors to benefit from improved sanitation measures.

4. NAPA-BASED PROJECTS DEVELOPED THROUGH THE LDCF

The next step in the NAPA implementation process is the development of projects through available funding mechanisms. The GEF-implemented Least Developed Countries Fund (LDCF) is a dedicated NAPA development and implementation fund. In addition to the 50 NAPA document development projects, 44 NAPA implementation projects[19] had, at the time of writing this report, been approved for funding by the LDCF (see Annex 3 for a listing of approved LDCF NAPA implementation projects), the vast majority of which are labelled "full size" projects (i.e. LDCF funding of more than US$2 million). Figures 8 and 9 provide an overview of LDCF-submitted projects by region and project category, respectively.

Figure 8
NAPA-related priority activities and LDCF projects by region

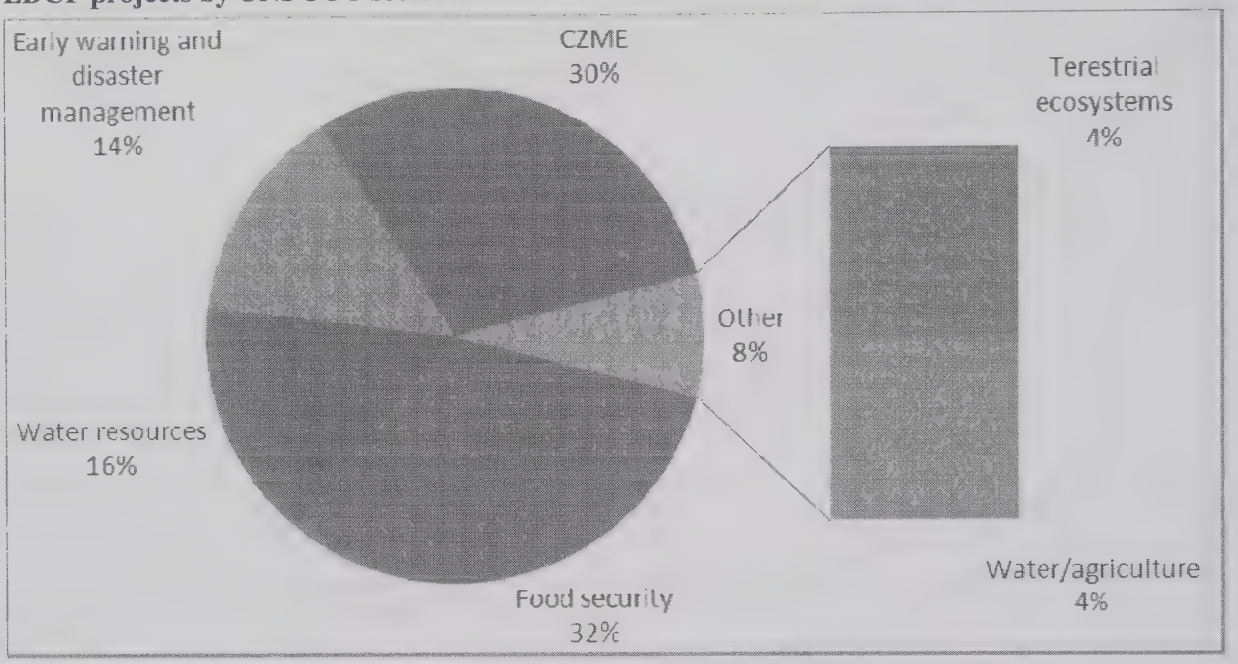




[19] This listing does not include the NAPA formulation activities funded by the LDCF as "enabling activities". As the LDCF budget is growing and follows an expedited process, the number of LDCF projects is expected to increase quite rapidly. For up-to-date information on LDCF projects, please refer to the GEF Project Database at www.gefonline.org/

More than 60 percent of the LDCF-submitted projects fall into the food security and coastal zones sectors, while the remainder are distributed among the water resources, terrestrial ecosystems and water/agriculture sectors.

Figure 9
LDCF projects by UNFCCC sector



Of the 44 LDCF-approved projects, 11 related to CZME projects, while 5 covered the fisheries and aquaculture sector. The countries whose projects address the fisheries and aquaculture sector were: Cambodia, Lao People's Democratic Republic, Niger, Sao Tome and Principe, and Senegal. The countries that had submitted CZME-related adaptation projects were: Bangladesh, Djibouti, Guinea, Haiti, Kiribati, Liberia, Maldives, Mozambique, Tuvalu, United Republic of Tanzania, and Yemen.

Table 9 provides an overview of the number of NAPA priority activities relating to the fisheries and aquaculture and CZME sectors, and the number of actual LDCF NAPA implementation projects currently approved that include these sectors. The projects submitted to the LDCF do not necessarily coincide with the priority activities elaborated in the NAPA documents, as these have been re-formulated before their application for LDCF funding and are not bound to the original NAPA priority activities lists as long as the proposed LDCF project shows a clear link to the original NAPA priorities. The majority of the LDCF projects integrate multiple priority activities into one LDCF project and, therefore, are much broader scope in comparison with the NAPA priority activities. This is perfectly in line with a more programmatic approach to developing LDCF projects. However, in some cases, countries that had elaborated fisheries and aquaculture NAPA priority activities have subsequently submitted projects targeting only the land-based agriculture and water management sectors, appearing to neglect the original fisheries and aquaculture component. Two examples are the re-formulation into LDCF projects of two NAPA priority activities by Malawi and Zambia, in which the fisheries and aquaculture component has been omitted.[20]

[20] The NAPA activities in question are "Improving community resilience to climate change through the development of sustainable rural livelihoods (aquaculture and processing)", which evolved into the LDCF project "Climate Adaptation for Rural Livelihoods and Agriculture (CARLA)", for Malawi, and "Adaptation of land use practices (crops, fish and livestock) in light of climate change", which evolved into the LDCF project "Adaptation to the effects of drought and climate change in Agro-ecological Zone 1 and 2 in Zambia".

Table 9
Overview of NAPA priority activities and LDCF-approved projects

Country	NAPA date	No. of priority activities in NAPA	Fisheries and aquaculture			CZME		
			Priority activities	Approved LDCF projects	Date of approval	Priority activities	Approved LDCF projects	Date of approval
Bangladesh	Nov 05	15	3			1	1	05/09/07
Benin	Jan 08	5	1			1		
Burundi	Feb 07	12	1					
Cambodia	Mar 07	20	2	1	06/10/09	1		
Cape Verde	Dec 07	3	0			1		
Chad	Feb 10	10	3					
Comoros	Nov 06	13	2			0		
Democratic Republic of the Congo	Sep 06	3	0			1		
Djibouti	Oct 06	8	0			2	1	05/09/08
Ethiopia	Jun 08	11	1					
Gambia	Jan 08	10	1			1		
Guinea	Jul 07	25	3			2	1	01/12/08
Guinea-Bissau	Feb 08	14	2			3		
Haiti	Dec 06	14	1			3	1	29/09/08
Kiribati	Jan 07	10	0			3	1	02/10/09
Lao People's Democratic Republic	May 09	12	0	1	29/11/10	0		
Liberia	Jul 07	3	0			1	1	26/03/09
Madagascar	Dec 06	15	0			1		
Malawi	Mar 06	5	2			0		
Maldives	Mar 08	11	1			4	1	18/11/09
Mali	Dec 07	19	3			0		
Mauritania	Nov 04	28	1			1		
Mozambique	Jul 08	4	3			1	1	11/08/10
Niger	Jul 06	14	2	1	25/08/09	0		
Samoa	Dec 05	9	0			1		
Sao Tome and Principe	Nov 07	22	4	1	24/08/09	0		
Senegal	Nov 06	4	1	1	30/07/10	1		
Sierra Leone	Jun 08	24	3			4		
Solomon Islands	Dec 08	7	1			1		
Sudan	Jun 07	5	1					
Togo	Sep 09	7	1			1		
Tuvalu	May 07	7	1			2	1	09/11/09
United Republic of Tanzania	Jan-07	14	0			0	1	12/01/09
Vanuatu	Dec 07	5	1			0		
Yemen	Apr 09	12	1			2	1	25/06/09
Zambia	Oct-07	10	1			0		

Notes: Valid as of 10 October 2010; does not include NAPA development projects. LDCF-developed projects are not necessarily the same as the NAPA priority activities.

4.1 Brief description of LDCF-approved projects linked to fisheries and aquaculture

As explained above, although the majority of projects submitted are based on NAPA priority activities, they differ from these in various aspects. No fisheries and aquaculture specific projects have been developed *per se*, but the sector has been included either directly as a key stakeholder or

implicitly as an ultimate beneficiary. Below are described the 5 LDCF projects that encompass the fisheries and aquaculture sector, followed by the 11 LDCF projects covering CZME.

4.1.1 Fisheries-and-aquaculture-related LDCF projects

Cambodia, while not yet having submitted a project directly linked to its fisheries and aquaculture NAPA priority activity, has an LDCF project "Vulnerability assessment and adaptation programme for climate change in the coastal zone of Cambodia considering livelihood improvement and ecosystems", which includes fish stock management as an element of integrated rural livelihoods. The project incorporates several NAPA priority activities targeting the water and agriculture sectors.

The LDCF project of the **Lao People's Democratic Republic**'s LDCF, "Improving the resilience of the agriculture sector in Lao PDR to climate change impacts", addresses climate change impacts on the agriculture sector. Its main goal is to strengthen climate change policy and activate a coordinated and strategic investment in climate change adaptation for agro-ecosystems. Among the activities, particular emphasis is placed on enhancing the capacity of sector planners and agricultural producers in understanding and coping with climate change impacts, training relevant organizations in target areas on community-based adaptation to climate change, and disseminating information on adaptive lesson learned. Fishers are among the beneficiaries of pilot adaptation modules, and small-scale investments will be provided to the fisheries sector aimed at developing resilience to climate change impacts (e.g. by planning new, diversified activities).

Niger has submitted to the LDCF the project "Niger: Implementing NAPA priority interventions to build resilience and adaptive capacity of the agriculture sector to climate change". Its main objectives are to develop resilience to climate change impacts in food production systems and to enhance institutional capacity to respond to climate change. The fisheries sector will benefit from interventions that will improve its adaptive capacity as promotion of fisheries management is foreseen as well as the elaboration and implementation of a legislative framework for the sector incorporating climate change concerns.

The highest priority identified in the NAPA of **Sao Tome and Principe** is coastal adaptation. Most of the coastal communities are strongly dependent on coastal fisheries for their livelihood, therefore the main aims of the LDCF project "Sao Tome and Principe adaptation to climate change" are to improve the resilience of vulnerable coastal communities to climate change, in addition to realizing an early warning system that will serve the whole coast and ensure safety at sea. Among the activities, some site-specific interventions outlined in the NAPA will be carried out, namely the construction of shelters for fishing vessels and infrastructure to protect vulnerable coastal housing. The fishers will be trained and equipped for coping with risks at sea related to hazardous climate events. The adoption of appropriate CZM will contribute to developing community-based adaptation to climate change impacts, through a participatory process that will involve selected, pilot coastal communities. An interesting feature of the project is the participatory approach to vulnerability mapping, which will be developed through consultations with vulnerable communities, and will indicate, besides the areas at risk from flooding and erosion, agreed adaptation strategies, including relocation in the event of climate-induced disasters.

Senegal's LDCF project "Climate change adaptation project in the areas of watershed management and water retention" concentrates on climate change impacts on agricultural production systems and associated value chains with a focus on the use of water resources. The fisheries sector is addressed by the second component of the project, "water harvesting and watershed management", where options of diversification of the production systems will be explored. Aquaculture and fish farming will be promoted on a small-scale pilot basis, which will assess potential climate change risks so as to reduce rural communities' vulnerability to climate change and minimize adverse impacts on their food security.

4.1.2 CZME-related LDCF projects

Bangladesh's LDCF project "Community based adaptation to climate change through coastal reforestation" aims at re-creating the mangrove cover along the coastlines in order to arrest the degradation of coastal soil and sand dunes, involving the local communities in the management of plantation, protection and stress-reduction activities. Furthermore, the project envisages the incorporation of climate change risk considerations into national and subnational policies and programmes.

Djibouti's LDCF project "Reducing impacts and vulnerability of coastal productive systems" focuses on three strategic areas: policy, ecosystem rehabilitation and disaster prevention. The project contemplates the implementation of ICZM and early warning systems.

Guinea's LDCF project "Increased resilience and adaptation to adverse impacts of climate change in vulnerable coastal zones" targets coastal policies at the national and subnational level, with the objective of integrating climate risk concerns into new planning and amending the regulatory texts that do not include climate risk management. Its primary goal is to reduce coastal inundation and erosion.

Haiti's LDCF project "Strengthening adaptive capacities to address climate change threats on sustainable development strategies for coastal communities" includes three basic activities: improving institutional capacity to incorporate climate risk into planning and shift from reactive risk management to proactive risk management; mainstreaming climate risks into existing investment frameworks; and implementing pilot community-based measures to demonstrate how to enhance climate change resilience in coastal zones.

Kiribati's LDCF project "Increasing resilience to climate variability and hazards" is focused on the phenomena of erosion and storm surges affecting the coast. Project components are the improvement of both water resource management and disaster risk management (DRM), in order to reduce the impact of drought and storm surges on the availability and quality of freshwater resources and to reduce the vulnerability of coastal communities. In addition, climate change concerns will be mainstreamed into water resources and coastal zones policies. The project also encourages broader community inclusion into management.

Liberia's LDCF project "Enhancing resilience of vulnerable coastal areas to climate change risks" promotes the adoption of ICZM in order to strengthen the adaptive capacity of the coastal areas to climate hazards such as SLR, which is causing degradation and acidification of the coastal soil. The project activities target policies and planning processes as well as social and organizational capacity to increase resilience among the target communities.

Maldives' LDCF project "Integration of climate change risks into the safer island development programme" addresses the NAPA priority activities 1 and 2 for strengthening the SIS and has four main components: capacity development (to improve climate risk information and analysis); policy support (to develop guidelines on coastal policies and planning); climate risk reduction (to integrate coastal protection measures with land-use planning); and knowledge management and learning (to ensure dissemination of lessons learned through the global adaptation learning mechanism).

Mozambique's LDCF project "Adaptation in the coastal zones of Mozambique" has three main objectives: management of climate change risks at the local, subnational and national levels; improvement of adaptive capacity of target communities and enhancement of coastal zone resilience to climate change; and documentation and dissemination of best practices. As coastal erosion is one of the main concerns for the coastal areas of the country owing to SLR, the LDCF project seeks to address it by improving land planning and use and investing in adaptation measures for coastal areas, such as ecosystem rehabilitation and restoration of dunes, mangroves and coral reefs.

Tuvalu's LDCF project "Increasing resilience of coastal areas and community settlements to climate change" implements community-based adaptation measures in coastal areas to reduce vulnerability

through community-based management of ecosystems and sustainable use of natural resources. The project also focuses on national and subnational policies recommending a strategic revision to incorporate climate change risk considerations and to develop cooperation and harmonization among different sectors.

The **United Republic of Tanzania** is an interesting case as there were multiple references to the fisheries sector across its NAPA document, but no priority activities targeting either the fisheries and aquaculture or CZME sectors. However, in December 2009, the country submitted an LDCF project focusing on coastal zones: "Developing core capacity to address adaptation to climate change in productive coastal zones". The objectives of the project are: "To develop institutional capacities to manage climate change impacts through improved climate information, technical capacity, the establishment of demonstration projects to reduce vulnerability in key vulnerable areas, and learning." In particular, seawater intrusion will be addressed, a phenomenon that has negative effects on the fishing communities along the coast.

Yemen's LDCF project "Integrated Coastal Zone Management" proposes the adoption of ICZM as a means of adaptation to climate change impacts for coastal communities. Through climate resilience plans and adaptive activities identified for pilot sites, climate change adaptation will be mainstreamed into ICZM. Institutional capacity will be strengthened and local climate change adaptation models will be developed. Fisheries will be a target sector for adaptation options. The fisheries project is focused on value-added fish waste processing and fish stocks rebuilding activities.

It should be noted that the NAPAs provide countries and development partners with a strategy for implementation of broader climate change adaptation activities. Therefore, in addition to LDCF adaptation projects, the Special Climate Change Fund (SCCF) and other mechanisms, such as the GEF Trust Fund – Climate Change Focal Area and the Adaptation Fund are used for implementing NAPA. Annex 4 provides a list of such funding mechanisms.

5. IS THERE A GAP?

5.1 Review of the incidence of fisheries and aquaculture in NAPAs

The fisheries and aquaculture sector is considered by many LDCs to be a critical sector because of its contribution to food security, income and other aspects of society. In the present assessment of the role played by the fisheries and aquaculture sector in NAPAs,[21] the choice has been made to consider only two elements: the inclusion of the sector in the NAPA document; and the presence of priority activities that cover the fisheries and aquaculture sector. The assessment was limited in its knowledge concerning detailed information on the NAPA preparation process (e.g. how many fisheries experts, policy-makers and stakeholders in the fisheries and aquaculture sector had effectively taken part in the process) and did not analyse the links to national fisheries and aquaculture policies and strategies; although the latter would be necessary in the development of NAPA implementation projects.

In this analysis, the fisheries and aquaculture sector was found to be an important sector and was included in the majority of the NAPAs (38 out of 44 NAPAs) (Table 10): 17 of which provided an elaborated analysis of the sector's importance and vulnerability; while 21 of which mentioned the fisheries and aquaculture sector only briefly. Bangladesh, Cambodia, the Lao People's Democratic Republic, Mali and Guinea, although not focusing primarily on the fisheries and aquaculture sector in their NAPAs, are countries where the sector contributes significantly either to the national economy or to food security. However, they all acknowledge the exposure of the fisheries and aquaculture sector

[21] For this purpose, the assessment has followed the methodology developed by Bojö and Reddy (2002) and successively adopted by Oksanen and Mersmann (2002) and utilized by Thorpe (2004) and Thorpe *et al.* (2005). This identifies four principal analytical categories for assessing the inclusion and the weight of the fisheries and aquaculture sector on poverty reduction strategy papers (PSRPs). The first category is the inclusion of fisheries in the document; the second is the causal linkages between fishery-related issues and poverty-related issues; the third is the fisheries-related responses; and the fourth is the link between the document formulation process and fisheries-related policies and planning.

to climate change impacts. Bangladesh quotes fisheries as one of the sectors most exposed to climate changes such as temperature rise, drought, SLR, floods, and cyclone and storm surges. Cambodia mentions that coastal fisheries may be adversely affected by SLR. More than 4 000 fish ponds have been lost during floods in the Lao People's Democratic Republic, as pointed in the country's NAPA. The fisheries and aquaculture sector is identified as one at risk of adverse climate change impacts by Mali,[22] in particular being prone to drought and windstorms. Guinea describes fishers as the second-most vulnerable socio-economic group to climate change impacts, the most vulnerable group being farmers.

Cape Verde, the Comoros, Kiribati, Liberia, Maldives, Sao Tome and Principe, Sierra Leone, Solomon Islands, Tuvalu and Vanuatu explicitly link fish and food security. The Comoros, the Gambia, Guinea-Bissau, Maldives, Solomon Islands, and Vanuatu describe fisheries as one of the most productive sectors for their economy.

Table 10
Overview analysis of the inclusion of fisheries and aquaculture sector in NAPAs

	No mention	**Mentioned**	**Elaborated/analysed**
Inclusion of fisheries and aquaculture sector in NAPA context descriptions	Afghanistan, Bhutan, Central African Republic, Ethiopia, Lesotho, Rwanda	Bangladesh, Benin, Burkina Faso, Burundi, Cambodia, Democratic Republic of the Congo, Djibouti, Eritrea, Guinea, Guinea-Bissau, Haiti, Lao People's Democratic Republic, Madagascar, Malawi, Mali, Mozambique, Niger, Sudan, Togo, Uganda, Yemen	Cape Verde, Chad, Comoros, Gambia, Kiribati, Liberia, Maldives, Mauritania, Samoa, Sao Tome and Principe, Senegal, Sierra Leone, Solomon Islands, Tuvalu, United Republic of Tanzania, Vanuatu, Zambia
	No links to fisheries and aquaculture sector	**Indirect links to fisheries and aquaculture sector through CZME NAPA priority activities**	**One or more NAPA priority activities directly linked to fisheries and aquaculture**
Inclusion of fisheries and aquaculture sector in NAPA priority activities	Afghanistan, Bhutan, Burkina Faso, Burundi, Central African Republic, Eritrea, Ethiopia, Lao People's Democratic Republic, Lesotho, Niger, Rwanda, Sudan, Uganda, United Republic of Tanzania	Benin, Cape Verde, Comoros, Democratic Republic of the Congo, Djibouti, Haiti, Kiribati, Liberia, Madagascar, Mozambique, Samoa	Bangladesh, Benin, Burundi, Cambodia, Chad, Comoros, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Malawi, Maldives, Mali, Mauritania, Mozambique, Niger, Sao Tome and Principe, Senegal, Sierra Leone, Solomon Islands, Sudan, Togo, Tuvalu, Vanuatu, Yemen, Zambia

As mentioned above, 17 LDCs had included an extensive analysis of the fisheries and aquaculture sector in their NAPA, and 27 had elaborated priority activities that cover the fisheries and aquaculture sector. The attention paid to the fisheries and aquaculture sector in the phase of elaboration of the NAPA activities suggests that the countries acknowledge the importance of the sector. For example, in the rationale for two of its priority activities Bangladesh highlighted the contribution of the sector to the socio-economic conditions of rural and coastal communities. The Sudan considered the introduction of fish species for nutritional and income generation purposes. Yemen, in the rationale of the priority activity, "Sustainable management of the fisheries resources", stressed the importance of the fisheries sector for its contribution to the national economy.

Some of the NAPA priority activities that target CZME are also concerned with the well-being of aquatic resources; for example, activities aiming at the restoration of the biodiversity of the marine and

[22] The country's NAPA assesses the exposure of 12 sectors to climatic risks, and the fisheries and aquaculture sector is classified as a third degree of exposure together with the energy sector (there are 12 degrees of exposure). The agriculture and health sectors are classified as first degree.

coastal ecosystems and those communities who depend on these resources for their food and livelihood security.

The LDCs that had not included either the fisheries and aquaculture or the CZME sectors into their NAPA adaptation priority activities were:

- West African countries: Burkina Faso;
- East African countries: Eritrea, Rwanda, Uganda and the United Republic of Tanzania;
- Central African countries: Central African Republic and Lesotho;
- Asian countries: Afghanistan, Bhutan and the Lao People's Democratic Republic.

The absence or insufficient inclusion of fisheries-and-aquaculture-related NAPA priority activities in countries where the sector has been identified as a vulnerable sector – either because fish production and consumption play an important role in food and livelihood security (Table 1) or because the impacts to the sector are expected to be high (Table 2) – is an aspect that should be considered in any NAPA revisions or NAPA implementation phases in order to assess whether the sector may be in need of additional planning for adaptation activities specifically targeting or including the sector. These include, for example:

- **Angola**, a highly food-insecure country in which fish consumption, reaching 15 kg per capita per year, contributes significantly to nutrition and in which a significant portion of the population is dependent on the fisheries industry for its livelihood.[23] The country is still in the process of NAPA elaboration, and it would seem appropriate that the importance of the fisheries sector be reflected in the document.
- The **Lao People's Democratic Republic**, a land-locked Asian LDC where per capita fish consumption exceeds 17 kg per year, but which did not include fisheries-and-aquaculture-related priority activities in its NAPA document. However, many of its NAPA priority activities address water management, and, as freshwater fisheries and aquaculture are dependent on water ecosystems, an integrated approach for adaptation strategies that takes into accounts the needs of these sectors would be recommended.
- **Uganda**, in which the fisheries and aquaculture sector was described as a key sector for the national economy, as well as a contributor to food security and increased economic household, and for which potential climate change impacts on the country's waterbodies were identified; nevertheless, it did not formulate NAPA priority activities with links to fisheries.

Most of the NAPA activities relevant for the fisheries and aquaculture sector dealt with one of the four adaptation strategies introduced in Chapter 3 of this report: livelihood strategies; governance regimes; disaster risk reduction and management, and planned adaptation. The activities that fell into the "management of fisheries resources" sector were focused on governance regimes. The aquaculture projects, fisheries technologies and post-harvest activities can be considered livelihood strategies. Planned adaptation was transversal across several activities, as many of the activities stressed the importance of incorporating climate change concerns into policies and programmes. Disaster risk reduction and management was the main goal of all activities concerned with early warning, monitoring activities, awareness raising and communication.

Regional fisheries and transboundary fisheries management issues have generally not been explicitly addressed in the NAPAs, given their national focus. As fisheries and aquaculture systems will often encompass issues at multiple scales, from local communities to watersheds and large marine ecosystems, additional guidance will be needed to understand the vulnerabilities and priorities at the relevant scales. Experience in developing LDCF projects at the regional or watershed scales should provide a means to exploring and addressing these issues.

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[23] FAO, Angola National Fishery Sector Overview.

In addition, the synergies and negative trade-offs among adaptation (and mitigation) strategies need to be identified and monitored. Adaptation measures in one sector can negatively affect livelihoods or vulnerability in other sectors. For example, river-based fisheries can be negatively affected by adaptations in other sectors upstream, such as an increased need for irrigation, which can reduce water flows and affect seasonal spawning and fish productivity. However, robust adaptation strategies, such as the promotion of diverse and flexible livelihood and food production strategies, flexible and adaptable institutions, food-security risk-reduction initiatives and planned food-security adaptation to climate change, should reduce trade-off risks and make the most of possible synergies among sectors (FAO, 2008b).

5.2 Conclusions and ways forward

This brief review of 44 NAPAs has supported the hypotheses that the fisheries and aquaculture sector: (i) is important to LDCs in terms of food security, poverty alleviation and economic development; (ii) is among the vulnerable sectors; and (iii) requires assistance for improving climate change adaptive capacity both in terms of cross-cutting efforts to increase vulnerable populations' resilience but also in terms of reducing vulnerabilities specific to these communities' dependence on aquatic systems for food and livelihoods security. These points are reflected in the fact that the fisheries and aquaculture sector is at least mentioned in the majority of the NAPAs reviewed. However, continued efforts are necessary to ensure the appropriate inclusion of the sector in the NAPA revision and implementation process. If, for example, a vulnerability analysis would suggest the inclusion of the sector in a country's NAPA but this has not happened, those responsible for the sector need to understand why this was the case; leading, hence, to a revision of the NAPA, a concerted effort to include the sector in NAPA implementation activities or to an agreement regarding the relatively low priority status attributed to the sector.

A mixed approach allowing for sectoral specificity while supporting integrated and holistic approaches to adaptation should be fostered in the NAPA implementation process, and this would probably happen if broad stakeholder groups were included in the participatory processes started during the NAPA development phase. However, these integrated/cross-sector projects may suffer from already existing institutional weaknesses and would require improved coordination across agencies, ministries, regional bodies and other stakeholders, such as the GEF agencies.

Stakeholders in the fisheries and aquaculture sector need to ensure proper inclusion of the sector in comprehensive NAPA projects, such as ICZM or water management projects. The priority activities and vulnerability discussions in this report may assist in doing so, but direct discussions with national climate change focal points and GEF executing agencies will be necessary.

In many cases, the NAPAs do not clearly address transboundary issues, such as shared fish stocks, migratory species or basin-wide fisheries management or ecosystem approaches. The lack of inclusion of these issues in many NAPAs is a risk to their successful implementation as they require regional or joint action among countries to succeed.

The continual adaptation of GEF modalities to support project implementation is welcomed. One such example is the increased ease with which GEF-administered funds may be combined and linked to other funding sources – increasing effectiveness of a programmatic approach and allowing for regional or transboundary issues to be addressed directly (e.g. enabling issues common to neighbouring LDCs and non-LDCs to be addressed).

Gaining experience and learning lessons from these experiences will only increase the effectiveness of the LDCF in its goal of assisting LDCs in implementing their NAPAs.

Finally, in many cases, the NAPAs were not specifically aligned to sector or development policies at the national level. Furthermore, regional and "global" best practices and voluntary agreed instruments for the sector should be specifically considered during NAPA implementation development. These include, for example, national fisheries policies, poverty reduction strategy papers (PRSPs), the

Millennium Development Goals (MDGs) and the United Nations Development Assistance Framework, DRM (Hyogo) frameworks, food-security frameworks, implementation of the Code of Conduct for Responsible Fisheries and application of the ecosystem approaches to fisheries and aquaculture. The strengthening of NAPAs should also specifically include actions to support poor marginalized groups and women.

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FISHERIES-AND-AQUACULTURE-SPECIFIC NAPA PRIORITY ACTIVITIES

Country	Project title	Priority ranking of activity	UNFCCC category	Number of years	Project cost (US$)	Main objectives
Bangladesh	Adaptation to fisheries in areas prone to enhanced flooding in northeast and central region through adaptive and diversified fish culture practices	13 of 15	Food security	n.a.	4 550 000	Introduce net fencing to prevent escaping of fish from culture ponds; promote pen and cage culture fish in floodplain areas during flood season as an alternative option for fish culture.
Bangladesh	Promoting adaptation to coastal fisheries through culture of salt-tolerant fish special in coastal areas of Bangladesh	14 of 15	Food security	5	4 050 000	Develop farming technology for salt-tolerant fish species for potential use in coastal aquaculture; pilot and promote aquaculture in priority areas; develop linkages with weather forecasting agencies; assist coastal aquafarmers, particularly shrimp farmers, in managing floods.
Bangladesh	Capacity building for integrating climate change in planning, designing of infrastructure, conflict management and land–water zoning for management institutions	3 of 15	Education and capacity building	n.a.	5 050 000	Incorporate climate change issues and concerns in water sector policies and plans; build planning capacity for water resources experts to address climate change hazards; adopt sustainable management of land and water zones in light of climate change; develop design manuals and identify vulnerable structures for planning of new infrastructure for adaptation.
Benin	Establishment of an early warning system for climatic risks and for food security in four vulnerable agro-ecologic zones	1 of 15	Cross sectoral	6	8 190 000	Provide prompt information to rural communities on upcoming climatic events that could damage production systems.
Burundi	Protection of the buffer zones in Lake Tanganyika floodplain and around the lakes of Bugesera	6 of 12	Terrestrial ecosystems	3	200 000	Maintain the hydrological and ecological functions of the floodplain around Lake Tanganyika and the marshes of Bugesera; establish strategic buffer zones in the floodplain of Lake Tanganyika and around the lakes of Bugesera; set up agreed regulations regarding buffer zone management.
Cambodia	Development and improvement of small-scale aquaculture ponds	11 of 20	Food security	3	4 000 000	Ensure food security in areas where wild fish stocks are insufficient to meet demand; increase the income of local communities.
Cambodia	Rehabilitation of upper Mekong and provincial waterways	5 of 20	Infrastructure	3	30 000 000	Reduce risks caused by Mekong floods; protect fisheries resources; improve rural livelihoods by supplying sufficient water for irrigation and domestic uses; improve provincial water transportation.
Chad	Improvement of information, education and communication for adaptation to climate change	4 of 10	Education and capacity building	3	1 100 000	Raise awareness on climate change risks; improve communication and information on adaptation strategies to climate change.

Country	Project title	Priority ranking of activity	UNFCCC category	Number of years	Project cost (US$)	Main objectives
Chad	Improvement of the quality of seasonal forecast for rain fall and surface water flow and their integration into an overall strategy for vulnerability	7 of 10	Early warning and disaster management	3	1 700 000	Improve the forecasting system; provide useful information on climate events and impacts to rural communities.
Chad	Reduction of the climate-change- related vulnerability of the populations/management of risks induced by climate change	10 of 10	Early warning and disaster management	3	2 000 000	Establish an early warning system; analyse the data collected on climate change; support cooperation among forecasting technical agencies and health services; sensitize population on climate change risks.
Comoros	Introduction of fish concentration mechanisms	9 of 13	Food security	n.a.	132 000	Increase fish availability in the face of shortages due to climate variability.
Comoros	Short conservation of fish under ice	11 of 13	Food security	n.a.	308 000	Improve the refrigeration procedure, from the catch places to the distribution places, in order to reduce and avoid fish deterioration after catches, due to temperature rises.
Ethiopia	Community based sustainable utilization and management of wet lands in selected parts of Ethiopia	5 of 11	Terrestrial ecosystems	n.a.	2 000 000	Conserve and wisely use selected wetlands to promote the adaptation capacity of the rural community for climate shocks.
Gambia	Increasing fish production through aquaculture and conservation of post harvest fishery products	10 of 10	Food security	4	300 000	Adopt a sustainable management of resources; manage weather hazards and improve fisheries productivity; reduce disequilibria between demand and supply of fish and fish products; explore alternative ways of fish production; develop aquaculture programmes for rural communities.
Guinea	Promoting the use of solar energy for fish drying to reduce pressure on mangroves	9 of 25	Energy	2	200 000	Contribute to mangrove preservation through the use of solar dryers.
Guinea	Promoting adaptation-oriented technologies. Training of the coastal community on environmentally friendly techniques to exploit oysters from mangrove ecosystems	4 of 25	Education and capacity building	4	250 000	Train local communities on exploitation of oysters from mangroves ecosystems; increase oysters production; contribute to mangrove protection.
Guinea	Protection of spawning areas in Fatale, Konkoure and Mellacore estuaries	21 of 25	Terrestrial ecosystems	2	250 000	Indentify and restore degraded zones in the estuaries; train fisherfolks on fishing techniques; raise awareness for the stakeholders in the area; assist fisherfolks associations.

Country	Project title	Priority ranking of activity	UNFCCC category	Number of years	Project cost (US$)	Main objectives
Guinea-Bissau	Protection, conservation and enhancement of fishing and coastal resources project	9 of 14	Coastal zones and marine ecosystems	2	450 000	Seek viable solutions, in collaboration with all stakeholders in the production field, for a responsible management of sea and coastal resources and environment; foster the sector's sustainable development through catch enhancement, mangrove and sea products; set up an institutional mechanism for mediation of conflicts on the use of coastal fishing resources.
Guinea-Bissau	Natural catastrophe prevention project	8 of 14	Early warning and disaster management	3	300 000	Establish a national centre for meteorological and hydraulic prevention; educate and sensitize population on meteorological and hydrological phenomena likely to provoke natural catastrophes; provide meteorological and hydrological forecasting.
Haiti	Reduction of inundations and improvement of agricultural conditions for the management of the northwest and northeast basins	4 of 14	Terrestrial ecosystems	4	3 564 479	Realize infrastructure to prevent erosion and protect the river banks; sensitize the population on climate change impacts; reintroduce vegetation in deforested areas through agro-forestry.
Malawi	Improving climate monitoring to enhance Malawi's early warning capability and decision-making and sustainable utilization of Lake Malawi and lakeshore areas resources	5 of 5	Early warning and disaster management	3	5 430 000	Establish a climate monitoring and early warning system on Lake Malawi and lakeshore areas for timely provision of information for pre-disaster preparedness for fishing and farming communities; promote short and long-term adaptation livelihood skills among riparian communities in the face of dwindling fish catches.
Malawi	Improving community resilience to climate change through the development of sustainable rural livelihoods (fish farming and processing)	1 of 5	Food security	3	4 500 000	Develop and promote sustainable livelihood strategies for communities vulnerable to climate change, such as those living in the Shire Valley.
Maldives	Investigating alternative live bait management, catch, culture and holding techniques in the Maldives to reduce vulnerability of the tuna fishery sector to the predicted climate change and variability	9 of 11	Food security	n.a.	1 027 000	Improve bait fishery management and explore alternative techniques of live bait catching, culture and storage to reduce vulnerability of bait fish to predicted sea surface temperature change.
Mali	Implementation of drilling equipped with solar- or wind-driven systems	8 of 19	Water resources	3	1 500 000	Sustain agricultural production (agriculture, farming, fisheries); address the needs of the communities in the area; protect the environment.
Mali	Implementation of a runoff water harvesting system and restoration of water points (backwater, ponds and lakes)	11 of 19	Water resources	3	280 000	Sustain agricultural production (agriculture, farming, fisheries); address the needs of the communities in the area; protect the environment.

Country	Project title	Priority ranking of activity	UNFCCC category	Number of years	Project cost (US$)	Main objectives
Mali	Rehabilitation of aquaculture sites in Mali	4 of 19	Food security	5	25 760 000	Build ponds for the sustainable use of aquatic resources; diversify activities for the optimization of the food production in zones where water management has been put in place; promote floating cages aquaculture in suitable zones.
Mauritania	Protection of the diversity of the fish population and prevention of over-fishing with a view to sustainable development	14 of 28	Coastal zones and marine ecosystems	5	1 337 000	Ensure the establishment of rules and norms preserving the fish habitat within coastal development planning; extend the monitoring of the resource which is currently limited to the EEZ; promote, through fish farming –targeted programmes – the genetic diversity of fish population; disseminate information, among the various stakeholders, on innovative fishing techniques.
Mozambique	Management of water resources under the climate change framework	4 of 4	Water resources	n.a.	2 000 000	Improve the monitoring of river waters and river water levels; improve the control systems of the river water levels for a greater precision in the forecast on drought and floods; strengthen the river water level control system through technical and capacity building of personnel; improve the systematic control level of river water quality.
Mozambique	Strengthening capacities of agricultural producers to deal with climate change	2 of 4	Education and capacity building	n.a.	2 500 000	Promote associations among farmers, cattle and goat breeders and fishermen; build systems for the collection and conservation of rain waters for subsequent use in the drought season; install small-scale sustainable irrigation systems, exploring the use of renewable energy.
Mozambique	Strengthening of an early warning system	1 of 4	Early warning and disaster management	n.a.	2 700 000	Strengthen the early warning system for the benefit of vulnerable communities; evaluate the current state and functionality of the early warning system; identify the local knowledge of forecasting climatic events and evaluate its adaptability in the early warning system; evaluate the degree of the climate risk.
Niger	Protection of riversides and restoration of silted up ponds	14 of 15	Terrestrial ecosystems	2	n.a.	Contribute to the protection and restoration of ecosystems to supply the vulnerable populations with sufficient water resources; contribute to the satisfaction of water needs for livestock and crops; fight against silting up of water ponds; stock water in the ponds for pastoral activities.

Country	Project title	Priority ranking of activity	UNFCCC category	Number of years	Project cost (US$)	Main objectives
Niger	Water control: mobilization of surface water and exploitation of ground water	7 of 15	Water resources	3	n.a.	Contribute to the reduction of poverty and improvement of food security through the mobilization of water resources. Increase the satisfaction rate of people and livestock's needs in the project areas; improve agricultural productions (agriculture, livestock farming, fisheries); contribute to the environment protection.
Sao Tome and Principe	Construction and installation of Fish Concentration Devices (DFC) along the coastal zones	4 of 22	Food security	2	250 000	Increase the production and the productivity of fisheries; reinforce communities participation through the construction of DFC; support the income and the safety of the fisherfolk.
Sao Tome and Principe	Training and readaption project of the new navigation technologies and fishing equipment for fishermen	1 of 22	Food security	n.a.	350 000	Enhance the craft sector; improve the navigation capacity of fishermen, to avoid life loss and incidents at sea.
Sao Tome and Principe	Establishment of a system of climate alert	2 of 22	Early warning and disaster management	1	500 000	Supply meteorological information to the marine and aerial navigation; maintain staff up dated; improve marine equipments and other infrastructures.
Sao Tome and Principe	Construction of infrastructure for protection of vulnerable communities	10 of 22	Coastal zones and marine ecosystems	n.a.	300 000	Involve target groups in the preservation of spaces destined to disembarkation and parking of canoes; reduce the degradation of the coast through the construction and completion of protection barriers; improve parks for embarkations of crate fishing and develop new harbours; build bridges for fishing fleets in degraded areas and facilitate the permanence of fishermen in their origin communities.
Senegal	Education and warning campaign	4 of 4	Education and capacity building	2	160 000	Improve communication and disseminate information on climate change; improve research and exchange information across sectors on climate change risk and impacts.
Sierra Leone	Delineation and restoration of vulnerable habitats and ecosystems in the western area of Sierra Leone	15 of 24	Terrestrial ecosystems	3	420 000	Prevent the destruction of vulnerable fishing habitats; reduce the decline of fishery productivity.
Sierra Leone	Improve on the quality on fisheries related data and research	16 of 24	Food security	3	455 000	Improve the quality of data and research on fisheries ecosystems.
Sierra Leone	Establishment of a permanent study programme of the multispecies fisheries in Sierra Leone	14 of 24	Food security	3	395 000	Improve knowledge on multi-species; generate species-specific habitat and physiology data; collect data on habitat characteristics; study the quantity, distribution and feeding habitats of other fish species with high commercial potential value; provide information on growth rates and mortality of selected species.

Country	Project title	Priority ranking of activity	UNFCCC category	Number of years	Project cost (US$)	Main objectives
Solomon Islands	Fisheries and marine resources/ improve the understanding of the effects of climate change and climate variability including El Nino Southern Oscillation on the inshore and tuna fishery resources	5 of 7	Coastal zones and marine ecosystems	n.a.	1 500 000	Integrate climate change adaptation (climate proofing) into construction of a roads and other infrastructure; adopt integrated coastal zone management; enhance food security.
Sudan	Strategies to adapt to drought induced water shortages in highly vulnerable area in central equatorial state	5 of 5	Cross sectoral	3	5 000 000	Monitor the land in order to locate micro-catchments, dams and bore wells; enlarge the water reservoirs behind the dams and water catchments; improve the use of filters and pipes for water supply to the villages and residential areas; introduce irrigation systems for pasture improvement and grazing management; develop extension training programmes for proper water management as well as plants and livestock husbandry; introduce new fish species for additional nutrition of high protein and income generation; raise awareness on water resources management.
Togo	Enhancing the livelihood of market gardener communities and fishermen in the coastal zone to increase capacity to adapt to the adverse effects of climate change	6 of 7	Coastal zones and marine ecosystems	3	2 150 000	Enhance the adaptive capacity of gardener and fisher communities in vulnerable zones and promote income-generating activities; protect the coast against saline erosion.
Tuvalu	Adaptation to near-shore coastal shellfish fisheries resources and coral reef ecosystems productivity	7 of 7	Coastal zones and marine ecosystems	3	398 500	Protect shellfish population; preserve coral reef ecosystem productivity; raise public awareness on climate-related risks.
Vanuatu	Community based marine resource management programmes (modern and traditional aquaculture)	3 of 5	Coastal zones and marine ecosystems	n.a.	1 000 000	Develop community based marine resource programmes, embracing both traditional and modern practices of aquaculture
Yemen	Sustainable management of fisheries resources	11 of 12	Food security	5	1 180 000	Improve sustainable management of fisheries resources through research, planning, regulation and monitoring; increase income derived from the fisheries sector through better quality and marketing of fish; ensure the establishment of rules and norms that protect fish habitats within the coastal development planning.
Zambia	Adaptation of land use practices (crops, fish and livestock) in light of climate change	6 of 10	Food security	n.a.	1 200 000	Raise awareness and train stakeholders on climate change risks; ensure food security, plan income generating activities and business opportunities for the different agricultural sectors; identify fish species best suitable for aquaculture under changing climate conditions.

Note: n.a. = not available.

COASTAL ZONES AND MARINE ECOSYSTEMS PRIORITY ACTIVITIES IN NAPAS WITH POTENTIAL LINKS TO THE FISHERIES AND AQUACULTURE SECTOR

Country	Project title	Priority ranking of activity	UNFCCC category	Number of years	Project cost (US$)	Main objectives
Bangladesh	Reduction of climate change hazards through coastal reforestation with community participation	1 of 15	Coastal zones and marine ecosystems	n.a.	23 000 000	Strengthen adaptive capacity; create a shelterbelt along the coastal zone; generate new employment opportunities.
Benin	Protection of coastal areas against sea level rise	5 of 5	Coastal zones and marine ecosystems	5	1 296 000	Correct the sediment unbalance, arrest the beach erosion; replant the mangroves and promote an improved technology of salt extraction with the use of wind and sun energy.
Cambodia	Community mangrove restoration and sustainable use of natural resources	15 of 20	Coastal zones and marine ecosystems	3	1 000 000	Stabilize the shoreline; reduce seawater intrusion; arrest coastal erosion and protect coastal areas from sea-storms.
Cape Verde	Integrated protection and management of coastal zones	3 of 3	Coastal zones and marine ecosystems	5	1 500 000	Increase the resilience of coastal zones to climate change through integrated management of coastal resources.
Democratic Republic of the Congo	Biodiversity conservation and restoration of Mangroves Marine Park	3 of 3	Coastal zones and marine ecosystems	n.a.	239 374	Provide the basic biologic and socio-economic information; promote the community development and improve the organization of traditional institutions and committees dealing with the natural resources management; promote environmental education and regeneration of mangrove forests.
Djibouti	Restoration of protected sites through the protection of coral reefs and mangrove vegetation	7 of 8	Coastal zones and marine ecosystems	n.a.	529 000	Protect the coastal ecosystem and reduce the Doraleh area vulnerability to climate change; implement the Marine Protected Areas guidelines.
Djibouti	Mitigation of climate change related risks for the production system of coastal areas through an integrated, adapted and participatory management involving grassroots organizations	1 of 8	Cross sectoral	n.a.	1 000 000	Restore mangroves in the Khon Angar zone; improve water access for local communities; improve agricultural practices and diversify subsistence activities.
Gambia	Restoration/protection of coastal environments	9 of 10	Coastal zones and marine ecosystems	3	2 300 000	Improve livelihood security and preserve biological diversity and ecological assets.
Guinea	Protection of cultivated areas neighboring the coast	13 of 25	Coastal zones and marine ecosystems	3	350 000	Rehabilitate the greenbelts and construct protection dams.
Guinea	Promotion of environmental education for coastal communities	15 of 25	Education and capacity building	3	200000	Support community participation in the management of the coastal ecosystems to prevent or diminish coastal erosion and saline intrusion.

Country	Project title	Priority ranking of activity	UNFCCC category	Number of years	Project cost (US$)	Main objectives
Guinea-Bissau	Coastal areas erosion monitoring project	5 of 14	Coastal zones and marine ecosystems	3	400 000	Monitor the erosion level of critical sites on the coastal zone; disseminate information on coastal erosion and explore options to minimize the phenomenon of coastal erosion in specific areas.
Guinea-Bissau	Observatory for mangroves monitoring and evaluation project	4 of 14	Coastal zones and marine ecosystems	2	800 000	Set up a tool for monitoring the mangroves' status and provide information on activities that have adverse impacts on mangroves.
Guinea-Bissau	Environmental education and communication in coastal areas project	11 of 14	Education and capacity building	3	200 000	Build capacities and competences for target groups on adaptation to climate change through natural resources management and biodiversity conservation; awareness raising activities for the local population.
Haiti	Restoration and protection of coastal areas in northwest and northeast provinces	6 of 14	Coastal zones and marine ecosystems	4	3 004 466	Protect marine and coastal ecosystems in an effective way; improve protection against floods, waves and salt intrusion and preserve the biological biodiversity of the coastal zone.
Haiti	Restoration and protection of coastal areas in west province	7 of 14	Coastal zones and marine ecosystems	4	2 775 960	Protect marine and coastal ecosystems in an effective way; improve protection against floods, waves and salt intrusion and preserve the biological biodiversity of the coastal zone.
Haiti	Restoration and protection of coastal areas in south and Grand-Anse province	8 of 14	Coastal zones and marine ecosystems	3	2 123 500	Protect marine and coastal ecosystems in an effective way; improve protection against floods, waves and salt intrusion and preserve the biological biodiversity of the coastal zone.
Kiribati	Coastal zone management and resilience enhancement for adaptation	3 of 10	Coastal zones and marine ecosystems	3	1 937 280	Raise public awareness of climate change impacts on coastal communities; develop a pilot community-based coastal management regime by establishing community associations; encourage community participation in coastal ecosystems programmes and streamline the regulatory framework to improve the resilience of coastal areas and ensure the sustainable use of coastal resources.
Kiribati	Upgrading, restoring, enhancing resilience of coastal defenses and causeways	9 of 10	Coastal zones and marine ecosystems	3	5 670 750	Prevent coastal erosion by upgrading existing seawalls; improve accessibility within atolls threatened, in some cases, by the inadequacy of road infrastructure design and minimize potential risks to geo-ecological assets by hazardous climate events.
Kiribati	Coral reef restoration, monitoring and stock enhancement	8 of 10	Coastal zones and marine ecosystems	3	586 750	Acquire detailed information on coral bleaching, including factors causing health problems to corals and ciguatera fish; establish and implement a sustainable monitoring programme for two atolls; pilot a restoration scheme for coral species in areas of low growth; establish marine protected areas and contribute to the health of coral reef through a stock enhancement plan.
Liberia	Coastal defense system for the cities of Buchanan and Monrovia: reducing the vulnerability of coastal urban areas to erosion, floods, siltation and degraded landscapes	3 of 3	Coastal zones and marine ecosystems	3	60 000 000	Restore and maintain the viability of coastal areas as sites for tourism, recreation and commercial activities; monitor the alteration of natural river systems due to construction of harbours and monitor beach erosion around sea ports.

Country	Project title	Priority ranking of activity	UNFCCC category	Number of years	Project cost (US$)	Main objectives
Madagascar	Rehabilitation of degraded coastal areas	7 of 15	Coastal zones and marine ecosystems	1	32 500	Adopt a sustainable management of the coastal zone (by reprofiling the coastal ridge, installing nets and trapping windbreaks, planting filao and mangroves and building hard coastal defence infrastructure).
Maldives	Coastal protection of safer islands to reduce the risk from sea induced flooding and predicted sea level rise	2 of 11	Coastal zones and marine ecosystems	n.a.	3 055 000	Adopt innovative coastal protection measures suitable for small islands.
Maldives	Enhance adaptive capacity to manage climate change related risks to fresh water availability by appropriate wastewater treatment technologies	5 of 11	Water resources	n.a.	1 500 000	Identify and demonstrate innovative, appropriate and cost-effective wastewater treatment and disposal systems and educate target communities on appropriate wastewater treatment.
Maldives	Increase resilience of coral reefs to reduce the vulnerability of islands, communities and reef dependant economic activities to predicted climate change	11 of 11	Coastal zones and marine ecosystems	n.a.	1 062 000	Increase the knowledge base and improve information on adaptation processes for coral reefs.
Maldives	Integration of future climate change scenarios in the safer island strategy to adapt to sea level rise and extreme weather risks associated with climate change	1 of 11	Cross sectoral	n.a.	248 820	Undertake a detailed hazard and vulnerability assessment for five of the proposed safer islands and develop a hazard mitigation and vulnerability reduction action plan for adaptation.
Mauritania	Protection and reinforcement of the dune bar along the coastline in Nouakchott	16 of 28	Coastal zones and marine ecosystems	5	1 018 000	Institute and make operational a supervisory structure for the protection of the coastline bar; reconstruct and cover in vegetation over 80% of the weakened structures of the coastline dunes and raise awareness among the population on areas at risk of climate change impacts.
Mozambique	Reduction of the impact of climate change in coastal zones	3 of 4	Coastal zones and marine ecosystems	5	2 000 000	Identify and map out eroded land units and coastal vegetation; identify rehabilitation techniques for dunes and mangroves to mitigate the effects of erosion; improve the legal and institutional framework to control and mitigate erosion and develop strategic actions to sensitize and disseminate results and good practices among coastal communities.
Samoa	Establishing conservation programs in highly vulnerable marine and terrestrial areas of community projects	8 of 9	Cross sectoral	n.a.	350 000	Improve sustainable biodiversity management plans of action; building resilience for communities in high priority areas; develop and update a data base inventory for assessment, monitoring and evaluation for climate change vulnerability and improve traditional biodiversity management practices.
Senegal	Protection of the coastal region and restoration of mangrove vegetation	3 of 4	Coastal zones and marine ecosystems	5	208 000	Reduce the coastal erosion in Sangomar; replant mangrove trees and promote sustainable, cost-saving techniques of energy production in mangrove zones.

Country	Project title	Priority ranking of activity	UNFCCC category	Number of years	Project cost (US$)	Main objectives
Sierra Leone	Rehabilitation of degraded coastal habitats in the northern region of Sierra Leone	18 of 24	Coastal zones and marine ecosystems	3	317 000	Restore the ecological integrity and productivity of coastal habitats; improve sources of livelihood for coastal dwellers and ensure proper management of coastal habitats.
Sierra Leone	Development of an integrated coastal zone management plan for Sierra Leone	17 of 24	Coastal zones and marine ecosystems	1	90 000	Develop an integrated coastal zone management plan to ensure both the economic development of the population and the ecosystem preservation.
Sierra Leone	Develop and enact appropriate policies and regulations relevant to the development of coastal communities, urban growth planning, and critical coastal ecosystem preservation	19 of 24	Cross sectoral	1	60 000	Develop appropriate policies and regulations for planning growth and development of coastal communities through coastal ecosystems preservation.
Sierra Leone	Establishment of a national sea-level observing system	20 of 24	Early warning and disaster management	1	180 000	Build an operational permanent sea-level observing station for monthly reporting on the status of the sea level and collect, analyse and make available data for practical and/or scientific applications.
Solomon Islands	Coastal protection/implementation of integrated coastal zone management	4 of 7	Coastal zones and marine ecosystems	n.a.	1750000	Integrate climate change adaptation (climate proofing) into construction of roads and other infrastructure and enhance self-reliance and food security in coastal areas.
Togo	Reinforcing the coastal protection system against coastal erosion in the east part of Lomé	3 of 7	Coastal zones and marine ecosystems	3	3 000 000	Protect the coastal zone from the erosion phenomenon; arrest beach reduction; restore the mangroves and reduce fresh and salt-water pollution.
Tuvalu	Strengthening of community based conservation programmes on highly vulnerable near-shore marine ecosystems	5 of 7	Coastal zones and marine ecosystems	3	1 906 500	Preserve coastal biological diversity; develop and strengthen community biodiversity conservation programmes; increase productivity of coastal marine ecosystems and enhance traditional and modern conservation practices.
Tuvalu	Increasing resilience of coastal areas and community settlement to climate change	1 of 7	Coastal zones and marine ecosystems	3	3 200 000	Arrest the erosion of the coastal area and increase protection for coastal communities against hazardous climatic events.
Yemen	Develop and implement integrated coastal zone management (ICZM)	1 of 12	Coastal zones and marine ecosystems	4	3 200 000	Develop an integrated coastal zone management plan and develop and implement four coastal management plans in the Red Sea and Arabian Sea.
Yemen	Planting and re-planting of mangroves and palms for adaptation to sea level rise	5 of 12	Coastal zones and marine ecosystems	5	2 450 000	Protect coastal wetlands, estuaries, aquifers and infrastructure from potential saline water intrusion, coastal flooding and sea level rise associated with climate change; restore mangrove forests and wetlands, preserve sand dunes and establish green belts in critical areas.

Note: n.a. = not available.

ANNEX 3

NAPA IMPLEMENTATION PROJECTS APPROVED FOR LDCF FUNDING (AS OF 19 OCTOBER 2010)

Country	Project name	GEF agency	GEF grant (US$)	Cofinancing total (US$)	Project status
Afghanistan	Building adaptive capacity and resilience to climate change in Afghanistan	UNEP	4 900 000	16 000 000	Council approved
Bangladesh	Community based adaptation to climate change through coastal afforestation	UNDP	3 300 000	6 080 000	CEO endorsed
Benin	Integrated adaptation programme to combat the effects of climate change on agricultural production and food security	UNDP	3 100 000	6 920 000	CEO endorsed
Bhutan	Reducing climate change-induced risks and vulnerabilities from glacial lake outbursts in the Punakha-Wangdi and Chamkhar Valleys	UNDP	3 445 050	3 486 224	IA approved
Burkina Faso	Strengthening adaptation capacities and reducing the vulnerability to climate change in Burkina Faso	UNDP	2 900 000	6 300 000	IA approved
Burundi	Enhancing climate risk management and adaptation in Burundi (ECRAMB)	AfDB	3 080 000	15 660 000	Council approved
Cambodia	Promoting climate-resilient water management and agricultural practices	UNDP	1 850 000	1 950 000	IA approved
Cambodia	Vulnerability assessment and adaptation programme for climate change in the coastal zone of Cambodia considering livelihood improvement and ecosystems	UNEP	1 635 000	2 985 000	PPG approved
Cape Verde	Building adaptive capacity and resilience to climate change in the water sector in Cape Verde	UNDP	3 000 000	13 680 000	IA approved
Comoros	Adapting water resource management in Comoros to increase capacity to cope with climate change	UNDP	3 400 000	5 500 000	CEO endorsed
Democratic Republic of the Congo	Building the capacity of the agriculture sector in DR Congo to plan for and respond to the additional threats posed by climate change on food production and security	UNDP	3 000 000	4 000 000	CEO endorsed
Djibouti	Implementing NAPA priority interventions to build resilience in the most vulnerable coastal zones in Djibouti	UNEP	2 000 000	1 897 000	CEO endorsed
Eritrea	Integrating climate change risk into community-level livestock and water management in the northwestern lowlands	UNDP	3 000 000	3 460 000	IA approved
Ethiopia	Promoting autonomous adaptation at the community level in Ethiopia	UNDP	5 307 885	22 650 000	Council approved
Gambia	Strengthening of the Gambia's climate change early warning systems	UNEP	930 000	1 085 000	PPG approved
Guinea	Increased resilience and adaptation to adverse impacts of climate change in Guinea's vulnerable coastal zones	UNDP	2 970 000	5 150 000	CEO endorsed
Guinea-Bissau	Strengthening resilience and adaptive capacity to climate change in Guinea-Bissau's agrarian and water sectors	UNDP	4 000 000	12 710 000	Council approved
Haiti	Strengthening adaptive capacities to address climate change threats on sustainable development strategies for coastal communities in Haiti	UNDP	3 500 000	7 000 000	Council approved
Kiribati	Increasing resilience to climate variability and hazards	IBRD	3 000 000	3 300 000	Council approved
Lao People's Democratic Republic	Improving the resilience of the agriculture sector in Lao People's Democratic Republic to climate change impacts	UNDP	4 445 450	4 445 450	Council approved

Country	Project name	GEF agency	GEF grant (US$)	Cofinancing total (US$)	Project status
Lesotho	Improvement of early warning system to reduce impacts of climate change and capacity building to integrate climate change into development plans	UNEP	1 595 000	1 763 000	Council approved
Liberia	Enhancing resilience of vulnerable coastal areas to climate change risks	UNDP	2 900 000	2 900 000	CEO endorsed
Liberia	Enhancing resilience to climate change by mainstreaming adaption concerns into agricultural sector development in Liberia	UNDP	2 381 500	6 080 000	Council approved
Malawi	Climate adaptation for rural livelihoods and agriculture (CARLA)	AfDB	3 000 000	24 505 000	CEO endorsed
Maldives	Integrating climate change risks into resilient island planning	UNDP	4 250 000	4 250 000	IA approved
Mali	Enhancing adaptive capacity and resilience to climate change in the agriculture sector in Mali	UNDP	3 000 000	6 765 000	CEO endorsed
Mali	Integrating climate resilience into agricultural production for food security in rural areas	FAO	2 106 818	4 150 000	Council approved
Mauritania	Support to the adaptation of vulnerable agricultural production systems	IFAD	3 500 000	4 500 000	Council approved
Mozambique	Adaptation in the coastal zones of Mozambique	UNDP	4 433 000	8 866 000	Council approved
Niger	Implementing NAPA priority interventions to build resilience and adaptive capacity of the agriculture sector to climate change	UNDP	3 500 000	10 950 000	IA approved
Rwanda	Reducing vulnerability to climate change by establishing early warning and disaster preparedness systems and support for integrated watershed management in flood prone areas	UNEP	3 160 000	3 300 000	CEO endorsed
Samoa	Integrating climate change risks into the agriculture and health sectors in Samoa	UNDP	2 000 000	2 100 000	CEO approved
Samoa	Integration of climate change risk and resilience into forestry management (ICCRIFS)	UNDP	2 400 000	2 400 000	Council approved
Sao Tome and Principe	Sao Tome and Principe adaptation to climate change	IBRD	3 250 000	3 290 000	Council approved
Senegal	Climate Change adaptation project in the areas of watershed management and water retention	IFAD	5 000 000	8 825 000	Council approved
Sierra Leone	Integrating adaptation to climate change into agricultural production and food security in Sierra Leone	IFAD	2 644 800	2 775 000	Council approved
Sudan	Implementing NAPA priority interventions to build resilience in the agriculture and water sectors to the adverse impacts of climate change	UNDP	3 000 000	3 000 000	IA approved
Tuvalu	Increasing resilience of coastal areas and community settlements to climate change	UNDP	3 000 000	3 080 000	CEO endorsed
United Republic of Tanzania	Developing core capacity to address adaptation to climate change in productive coastal zones	UNEP	3 100 000	7 650 000	Council approved
Vanuatu	Increasing resilience to climate change and natural hazards	IBRD	2 577 272	3 150 000	Council approved
Yemen	Integrated coastal zone management	IBRD	4 500 000	10 000 000	Council approved
Zambia	Adaptation to the effects of drought and climate change in Agro-ecological Zone 1 and 2 in Zambia	UNDP	3 450 000	7 000 000	CEO endorsed

Source: GEF Project Database (www.gefonline.org).

ANNEX 4

EXAMPLE ADAPTATION AND MITIGATION FUNDS

Areas of focus	Fund	Type	Administered by	Web link
Adaptation	Adaptation Fund	Multilateral	Adaptation Fund Board	www.adaptation-fund.org/About
Adaptation	GEF Small Grants Programme	Multilateral	UNDP	http://gef.undp.kg/en/main_en.html
Adaptation	International Development Association	Multilateral	World Bank	www.worldbank.org/ida/
Adaptation	Japan Cool Earth Partnership	Bilateral	Government of Japan	www.mofa.go.jp/policy/economy/wef/2008/mechanism.html
Adaptation	Least Developed Countries Fund	Multilateral	Global Environment Facility	http://napa-pana.org/?q=en/node/27
Adaptation	Pilot Programme for Climate Resilience	Multilateral	World Bank	www.climateinvestmentfunds.org/cif/ppcr
Adaptation	Special Climate Change Fund	Multilateral	Global Environment Facility	www.thegef.org/gef/sccf
Adaptation	Strategic Priority on Adaptation	Multilateral	Global Environment Facility	www.climatefundsupdate.org/listing/strategic-priority-on-adaptation
Adaptation	Sustainable Energy and Climate Change Initiative	Multilateral	Inter-American Development Bank	www.iadb.org/topics/climateChange/secci/index.cfm?
Adaptation and DRR	Global Facility for Disaster Reduction and Recovery	Multilateral	World Bank	www.gfdrr.org/gfdrr/
Adaptation, mitigation, general	Climate Investment Funds	Multilateral	Clean Technology Fund and the Strategic Climate Fund	www.climateinvestmentfunds.org/cif/node/2 www.climateinvestmentfunds.org/cif/node/3
Adaptation, mitigation, general	ClimDev-Africa Special Fund	Multilateral	African Development Bank	www.afdb.org/en/topics-sectors/initiatives-partnerships/climate-for-development-in-africa-climdev-africa-initiative/
Adaptation, mitigation, general	Environmental Transformation Fund-International Window	Bilateral	Government of the United Kingdom	www.climatefundsupdate.org/listing/environmental-transformation-fund
Adaptation, mitigation, general	GEF Trust Fund-climate change focal area (GEF 4)	Multilateral	Global Environment Facility	www.climatefundsupdate.org/listing/gef-trust-fund
Adaptation, mitigation, general	GEF Trust Fund-climate change focal area (GEF 5)	Multilateral	Global Environment Facility	www.climatefundsupdate.org/listing/gef-trust-fund
Adaptation, mitigation, general	Hatoyama Initiative	Bilateral	Government of Japan	www.climatefinanceoptions.org/cfo/node/63
Adaptation, mitigation, general	International climate Initiative	Bilateral	Government of Germany	www.bmu-klimaschutzinitiative.de/en/home_i
Adaptation, mitigation, general	MDG Achievement Fund, Environment and Climate Change thematic window	Multilateral	UNDP	www.mdgfund.org/content/environmentandclimatechange

Areas of focus	Fund	Type	Administered by	Web link
Adaptation, mitigation, REDD mitigation, general	Amazon Fund (Fundo Amazonia)	Multilateral	Brazilian Development Bank (BNDES)	www.amazonfund.gov.br/FundoAmazonia/fam/site_en
Adaptation, mitigation, REDD mitigation, general	Global Climate Alliance	Multilateral	European Commission	www.gcca.eu/pages/1_1-Accueil.html
Adaptation, mitigation, REDD mitigation, general	Strategic Climate Fund	Multilateral	World Bank	www.climateinvestmentfunds.org/cif/node/3
Biodiversity	French Fund for the Global Environment	Bilateral	Government of France	www.afd.fr/jahia/Jahia/site/ffem/lang/en/accueil/pid/3566
Biodiversity, mitigation, REDD	Climate Change Fund	Multilateral	Asian Development Bank	www.adb.org/Climate-Change/cc-fund.asp
Catastrophe risk insurance	The Caribbean Catastrophe Risk Insurance Facility (CCRIF)	Multilateral	–	www.ccrif.org/content/aboutus/ccrif-organisational-structure
Mitigation, general	Clean Technology Fund	Multilateral	World Bank	www.climateinvestmentfunds.org/cif/node/2
Mitigation, general	Global Energy Efficiency and Renewable Energy Fund	Multilateral	European Commission	http://geeref.com/
Mitigation, general	Scaling-up Renewable Energy Program for Low Income Countries	Multilateral	World Bank	www.climatefundsupdate.org/listing/scaling-up-renewable-energy-program
Mitigation, REDD	Congo Basin Forest Fund	Multilateral	African Development Bank	www.cbf-fund.org/
Mitigation, REDD	Forest Carbon partnership Facility	Multilateral	World Bank	www.forestcarbonpartnership.org/fcp/
Mitigation, REDD	Forest Investment Program	Multilateral	World Bank	www.climateinvestmentfunds.org/cif/node/5
Mitigation, REDD	UN–REDD Programme	Multilateral	UNDP	www.un-redd.org/

Note: REDD = United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries.

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